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FOREWORD

THIS IS THE THIRTEENTH VOLUME in the series of *Memorial Tributes* compiled by the National Academy of Engineering as a personal remembrance of the lives and outstanding achievements of its members and foreign associates. These volumes are intended to stand as an enduring record of the many contributions of engineers and engineering to the benefit of humankind. In most cases, the authors of the tributes are contemporaries or colleagues who had personal knowledge of the interests and the engineering accomplishments of the deceased.

Through its members and foreign associates, the Academy carries out the responsibilities for which it was established in 1964. Under the charter of the National Academy of Sciences, the National Academy of Engineering was formed as a parallel organization of outstanding engineers. Members are elected on the basis of significant contributions to engineering theory and practice and to the literature of engineering or on the basis of demonstrated unusual accomplishments in the pioneering of new and developing fields of technology.

The National Academies share a responsibility to advise the federal government on matters of science and technology. The expertise and credibility that the National Academy of Engineering brings to that task stem directly from the abilities, interests, and achievements of our members and foreign associates, our colleagues and friends, whose special gifts we remember in these pages.

Thomas F. Budinger
Home Secretary

Memorial Tributes

NATIONAL ACADEMY OF ENGINEERING

M. Robert Aaron

M. ROBERT AARON

1922–2007

Elected in 1979

"For contributions to design tools and systems concepts essential for the realization of digital communications on the telephone network."

BY SANJIT K. MITRA

M. ROBERT AARON, a key contributor to the design of the T1 carrier system, the first practical digital system in the world designed for the exchange telephone plant, died on June 16, 2007, at his home in West Palm Beach, Florida, at the age of 84. He was elected to NAE in 1979 for "contributions to design tools and systems concepts essential for the realization of digital communications on the telephone network."

Bob was born on August 21, 1922, in Philadelphia, Pennsylvania. He met Wilma Spiegelman in 1942, shortly before he joined the U.S. Coast Guard during World War II. They were married in 1944, after he returned from active duty. He then studied electrical engineering at the University of Pennsylvania in Philadelphia, where he received his B.S. in 1949 and M.S. in 1951. After graduation, he joined Bell Laboratories in New Jersey, where he worked until his retirement in 1989.

During his career at Bell Labs, Bob was associated with many "firsts." Initially, he worked on the design of networks, filters, and repeaters for a variety of circuits for analog transmission systems, such as the equipment for the first color transmission of the Orange Bowl football game and equalizers for the L3 coaxial system. He made fundamental contributions to computer-aided design and applied these techniques to the development of the first repeatered transatlantic cable system in 1956.

Also in 1956, he began working on the development of digital transmission systems. The T1 carrier system was introduced by Bell into commercial service in 1962. One of Bob's former colleagues at Bell Labs, Dr. John Mayo, writes: "Six problems threatened the viability of high-speed digital communications in the telephone network. Bob Aaron made major contributions to overcoming five and had a strong supporting role in overcoming the sixth. His role was at the very heart of innovation, for he analyzed every aspect of what became the T1 carrier system [which] remains an essential element in global digital communications." Dr. Irwin Dorros, another former colleague at Bell Labs, described the T1 format as an influence on "the backbone of Internet transmission."

Bob's next focus was on the search for new techniques for high-speed digital systems. From 1968 until his retirement in 1989, he was head of the Digital Technologies Department. Initially, he was involved in the development of a variety of digital terminals for transmission and switching. In later years, he was responsible for exploratory development of digital signal processing terminals and techniques.

Over the years, Bob published more than 50 papers and was awarded many patents in circuit design, control, and communications. Several of his papers have been republished in collections of benchmark publications. He also gave many technical presentations, taught short courses at universities, chaired international meetings, and published some original poems in technical journals.

As an undergraduate, Bob had been president of the student branch of the joint AIEE/IRE society, the forerunner of IEEE, at the University of Pennsylvania, and he continued to be an active member of IEEE in various capacities after joining Bell Labs. He was a key player in the establishment of the IEEE Control Systems Society, was chairman of the first Papers Review Committee, and was secretary of the organization. He was an associate editor of the *IEEE Transactions on Circuits and Systems* from July 1969 to June 1971, and president of the IEEE Circuits and Systems Society in 1973. He was also a member of the Publications Committee of the Technical Activities Board (TAB), a working member of many other IEEE committees, a member of the TAB Finance Committee, and chairman of the Digital Systems Subcommittee of the IEEE Communications Society.

Bob received many awards and honors for his professional accomplishments. He was elected a fellow of IEEE in 1968 "for contributions to the analysis of PCM systems" and a fellow of the American Association for the Advancement of Science. He was co-recipient, with John S. Mayo and Eric E. Sumner, of the 1978 IEEE Alexander Graham Bell Medal "for personal contributions to, and leadership in, the practical realization of high-speed digital communications" and the 1988 NEC C&C Prize for "pioneering contributions to the establishment of a basic technology for digital communications by development of world's first practical commercial high-speed digital communication system: T1." He received the IEEE Centennial Medal in 1984, the McClellan Award of the IEEE Communications Society in 1985, and a Lifetime Service Award from the IEEE Communications Society in 1997. In 1999, he was the recipient of the International Telecommunications "Cristoforo Columbo" Award for his contributions to the development of digital communications systems, reduced bit-rate coding, and fast packet-switching systems.

Dr. John Mayo, Bob's colleague, remembered that "Upon winning the Japanese C&C Prize, [Bob] decided to deliver his acceptance speech in Japanese, even though he had no knowledge of the language. When asked why, he replied, 'Because they would appreciate it.' That showed the sensitivity, commitment, diligence, confidence, and excellence that Bob brought to all his work. And when the speech was over, the Japanese said exactly what his co-workers said about all Bob's work, "Done perfectly."

Dr. David Messerschmitt, who worked in Bob's group in the 1970s before joining the University of California, Berkeley, as a professor, recalls that "Bob was always a friend more than a boss. He was supportive in every way imaginable and was always available, including for lunch and coffee breaks, to interact informally with the 'troops'. By the time I knew him, Bob took the role of facilitator rather than individual technical contributor.

He mostly worked through us, seeding us with ideas and disabusing us of our misconceptions."

I joined Bob's group at Bell Labs in New Jersey, after a two-hour telephone interview with him, and met him for the first time in July 1965. He became my mentor and great friend, and I benefited tremendously from my friendship and close association with him. We collaborated on several projects, which led to several papers. After about a year, I informed Bob of my intention to take an academic post on the West Coast. He was supportive of my decision as he felt academe would be beneficial to Bell Labs in the long run.

Professor David Messerschmitt made a similar observation. "At one point I made it known that I was really interested in a career in academe. Although [Bob] was conflicted about this, he always saw academe as complementary rather than competitive. He never wavered in fully supporting my personal goals, while, at the same time, he manipulated the system to make it more attractive for me to stay. His approach was always the carrot, never the stick."

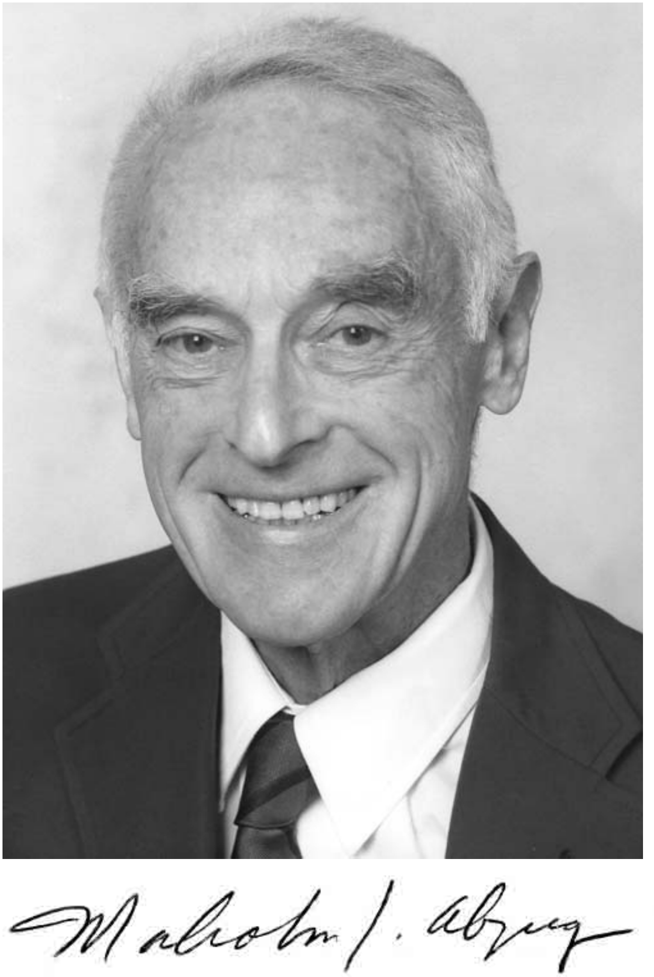
A very fine athlete, Bob enjoyed playing tennis, basketball, and ping-pong. He picked up golf in his later years. Professor Ernest S. Kuh remembers, "Socially I got to know his interest in sports and found out he was a wonderful ping-pong player. We played during lunch hour and decided to join a competition at Murray Hill. We were thrilled that before long we won the championship for doubles."

Bob always found time to participate in community activities. He was a member of the local school board in the 1960s when his two sons were in elementary school. In the 1970s, he was a tutor for the local branch of the NAACP. He was actively involved in the Union of Concerned Scientists.

After being diagnosed with multiple myeloma, Bob worked with the International Myeloma Foundation to promote the education and support of people with this form of cancer. Dr. Irwin Dorros, a colleague at Bell Labs, commented, "In his final years . . . he took part in his own medical treatments by making a second career of studying the causes and the options for the treatment of his ailments. He became a very active participant in the promotion of stem cell research and received major recognition in a field of much younger researchers." He also volunteered at the local Cancer Institute helping other cancer patients.

I kept in touch with Bob and Wilma regularly after leaving Bell Labs, and visited them whenever I was near their home, otherwise by telephone. In June 2007, when I telephoned Bob and I asked how he was doing, he said, in a very soft voice, "Sanjit, I am very sick." I didn't realize at the time that would be the last time I spoke to him. I and everyone else who worked with him at Bell Labs and elsewhere will miss him greatly.

Bob and Wilma had two children, Richard and James. Richard died a few years ago of a brain tumor. Bob is survived by Wilma, James, and James' two children.



MALCOLM J. ABZUG

1920–2007

Elected in 1996

"For contributions to aircraft and missile dynamics, control, and guidance."

BY ROBERT F. STENGEL
SUBMITTED BY THE NAE HOME SECRETARY

MALCOLM J. ABZUG, a leading aeronautical engineer who contributed to the development of many aircraft and published widely, died on May 23, 2007, at the age of 87. He was elected to NAE in 1996 "for contributions to aircraft and missile dynamics, control, and guidance."

Born in New York on April 13, 1920, Malcolm attended the Massachusetts Institute of Technology (MIT), where he earned an S.B. in aeronautical engineering in 1941. He pursued graduate studies at the University of California, Los Angeles (UCLA), where he was awarded an M.S.E. in 1959 and a Ph.D. in 1962. From 1962 to 1970, he was a lecturer and acting professor of engineering at UCLA. A decade later (from 1980 to 1986), he resumed teaching as an adjunct professor of engineering at the University of Southern California.

After graduating from MIT, Malcolm joined the U.S. Air Corps Aircraft Laboratory as an assistant aeronautical engineer. Commissioned as a naval officer in 1943, he worked with the Bureau of Aeronautics to improve aircraft-flying qualities until 1946. After World War II, he became an aerodynamicist at the Douglas Aircraft Company, then a project engineer at the Sperry Gyroscope Company. Malcolm returned to Douglas in 1952 to become chief engineer of the Advanced Flight Mechanics Department at the Missiles and Space Division, a position that he held until 1966.

While at Douglas, Malcolm was the lead stability and control engineer for the Douglas A2D-1 Skyshark and A4D-1 Skyhawk. As chief engineer, he contributed to the design and analyses of the F3D Skyknight and A3D Skywarrior. He quickly became known as an expert on control systems jets. In *Airplane Stability and Control: A History of the Technologies that Made Aviation Possible* (Cambridge University Press, 1997, 2002), a book he co-authored with E. Eugene Larrabee, Malcolm described the jet aircraft of this period as "jets at an awkward age." He was working in an era when aerodynamic and propulsion technology enabled planes to fly higher and faster than their electromechanical control devices could handle.

In 1966, Malcolm became manager of the Controls Design and Development Department at TRW Systems. He left the company in 1972 to become president of ACA Systems Incorporated, a consulting firm he headed until his final years. As a consultant, he worked with numerous aerospace and research organizations, including Northrop Aircraft, Ford Aerospace, Brunswick, Sparta, Science Applications International Corporation, Pacific Sierra, DARPA, and the Canadair Corporation.

Malcolm kept advancing the state of the art, inventing new methods of analyzing aeroelastic and fuel-sloshing effects, the coupling of multi-axis motions, flight through wind shear, precise measurements of air data, and the control of spacecraft attitude. During his association with Northrop, Malcolm contributed to the development of the YA9-1 attack aircraft, YF-17A fighter (a precursor of the Navy's F/A-18 Hornet), and the B-2 Spirit stealth bomber. In a career that lasted more than 50 years, he saw feedback flight-control systems evolve from non-existence to an afterthought to a necessity.

Malcolm wrote a number of books, not all of them technical. *Airplane Stability and Control* was a history of aviation, a compendium of the technical problems that arose during the development of airplanes, and a manual for solving stability and control problems. As a guide to the design of new aircraft, it is technical, complex, and deep, yet it rarely refers to equations. In this way, it adds a much needed dimension to the study of aeronautical engineering, which has increasingly focused on mathematics and numerical methods. Malcolm saved the latter for another book, *Computational Flight Dynamics* (AIAA Education Series, 1998), which contains enough equations and computer programs to warm the heart of the most analytical reader.

In *Aeronautical Engineer: From Waco Gliders to the Stealth Bomber: the Autobiography of Malcolm J. Abzug* (self-published, 1993), Malcolm opened his soul in a way unusual for an engineer. Known in Pacific Palisades, California, as a community activist and selfless volunteer, he wrote *Palisades Oil: A Community Battles over Oil Drilling* (self-published, 1991), which recounts a 22-year history of the issue.

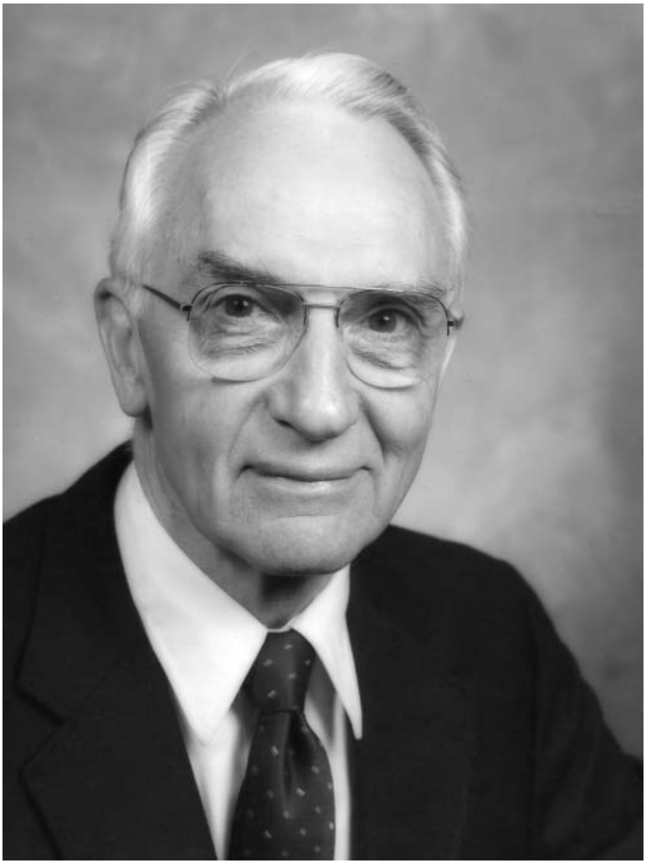
A well-known figure in the aerospace community, Malcolm was an active member of the American Institute of Aeronautics and Astronautics (AIAA), serving as chairman of the Flight Mechanics Committee and the Los Angeles Section. He was elected an AIAA Fellow in 1974. He also served on numerous government and industry committees, including the NACA Subcommittees on Stability and Control and Automatic Stabilization and Control, the DARPA Forward Swept Wing (X-29) Committee, the Naval Advisory Panel on Remotely Piloted Vehicles, and the Northrop Blue Ribbon Committee for the YF-17A. He was the recipient of the Engineering Achievement and the Bayonet Program Awards from Douglas Aircraft in 1957 and 1964.

Aviation was Malcolm's passion as well as the foundation of his career. As an MIT undergraduate, he designed an "all-balsa speedster of crashproof design," as he described his Swallow model plane in an article for the April 1939 issue of Air Trails magazine. Not surprisingly, Malcolm was a pilot with more than 1,500 hours of flying time. He held a commercial pilot's license, with multi-engine, instrument, and glider ratings, and he was a member of the American Soaring Society. His friend, Bill Rodden, remembers, "We both flew at Van Nuys in the Eight Ball Flying Club. . . . He was a good pilot—he could land much better than I." According to Bill, Malcolm was noted for flying both very low and very high. He "buzzed" the Rose

Bowl one New Year's Day, flying at an altitude of 2,000 feet when the minimum was 2,500 feet. He also set a glider altitude record over the Mojave Desert; however, the record was broken before he could record it, so his achievement was never officially recognized.

Malcolm's community interests led him to serve on the boards of the Palisades Human Relations Council, Pacific Palisades Residents Association, No Oil, Inc., Graffiti Busters, the Village Green Committee, and the Temescal Canyon Association. He helped build and maintain hiking trails in the Santa Monica Mountains with a local Sierra Club crew, and he taught middle schoolers how to plant vegetable gardens. He received the Pacific Palisades Community Service Award in 1997 and the Trail Volunteer of the Year Award in 2001. On accepting the 1997 award, Malcolm remarked, "I enjoy giving to the community. The work means a great deal to me. I feel honored to be awarded for something I do with great pleasure."

He is survived by his wife of 61 years, Gordon Breedon Abzug, two sons, Michael David Abzug of Los Angeles, California, and Mark McGregor Abzug of Scottsdale, Arizona, seven grandchildren, and one great grandson. His wife remembers that "Mal brought the same commitment and vigor to family life that he gave to his aeronautical career, but with a difference. He was a very loving husband, father, and grandfather, but with us, he was a relaxed and funny man. The family traveled, sailed, and biked together. He made many wooden toys and furniture for the children that they enjoyed more than their bought toys. His presence was keenly felt by his family then and now. He was a lovely man who will be missed."



LAURENCE J. ADAMS

1921–2008

Elected in 1988

"For exceptional engineering leadership in space vehicle systems."

BY ALBERT WESTWOOD

LAURENCE J. ADAMS, former president and chief operating officer of the Martin Marietta Corporation, was born in Madelia, Minnesota, in 1921, and died on February 13, 2008, at the age of 86. He was elected to the National Academy of Engineering in 1988 for "exceptional engineering leadership in space vehicle systems."

Larry Adams' choice of a career in aerospace was foreseen when he left the farm on which he was born and joined the U.S. Naval Reserve in 1942 to train as a pilot. He became an outstanding aviator, and so was chosen to become one of the first of the Navy's pilots to fly nighttime submarine spotting missions off the decks of the small aircraft carriers that served as convoy escorts in the Atlantic. Fortunately, most of his later career challenges were considerably less risky than landing a Grumman Avenger onto the heaving deck of a relatively small ship guided by just a few handheld torches.

After completing his active military service in 1946, Larry learned that he could apply his service credits toward a degree in aeronautical engineering at the University of Minnesota. This he did, graduating with his bachelor's degree in 1948. During that time, he also met Marguerite "Peggy" Gaetz, the lady who would later become his beloved wife for 56 years.

After graduation, Larry joined the Glen L. Martin Aircraft Company in Baltimore, Maryland, as a stress analyst, and began work on a variety of projects including the Matador/Mace Guided Missile, the Viking Sounding Rocket, the Oriole Air-to-Air Guided Missile, and a tactical bomber for the U.S. Air Force. His capability for, and tenacity in, solving tough engineering problems did not go unnoticed, and when the company (by then the Martin Company) was awarded the contract to build the Titan 1 Intercontinental Missile, and the company decided to build it in Denver, Larry was invited to transfer there as head of the stress analysis group. He later said that he made the decision to accept this position "in about ten milliseconds."

Upon his arrival, he found that his first challenge was to develop the technology to weld the strongest aluminum alloy of that time, ST14 . . . which was generally considered to be unweldable . . . and then to solve any problems likely to arise when the now welded ten foot diameter test tank contracted on being filled with liquid nitrogen or, later, liquid oxygen.

Many of the challenges Larry's group had to overcome are described in the book *Raise Heaven and Earth* (Simon and Schuster, 1993) by William Harwood. They included, for example, how to simulate the gravity force that the propellants and tankage might be subjected to at the point of maximum dynamic pressure as the rocket soars from the launch pad. Harwood also describes some of the spectacular calamities that befell his team when the tests they ran did not work out quite as expected!

The next few years of Larry's career read like the index to a book on the U.S. space program. He quickly advanced from program manager for the Titan II to technical director for the Titan III, IIIA and IIIC space launch systems, and program director for the Titan IIIM.

In 1965, Larry was promoted to director of engineering for the Denver division of the company and, over the next few years, was responsible for leading the teams that developed, for example, the multiple docking adapter for NASA's Skylab, the Viking Mars Lander, and the engineering integration tasks for the latter's incredibly successful mission. Other promotions followed, including vice president for special projects, for operations, and then general manager of the Denver division.

In the latter position, he was responsible not only for various ongoing Titan III missions, but also for developing the foundation technologies for a variety of emerging strategic missile and military information systems. Along with others, Larry exemplified the Martin culture of always accepting personal responsibility for things that, on occasion, went wrong . . . and then for promptly fixing them to achieve "mission success."

Larry's quiet managerial style, incredible technical and organizational competence, and string of successful major projects, made him the logical choice to become the next president of the aerospace division of the company, which, by 1976, had become the Martin Marietta Corporation, a diversified, multibillion dollar conglomerate, with major businesses in aerospace, cement, aggregates, dyestuffs, metals and, by virtue of its management responsibilities for the Oak Ridge National Laboratories, nuclear energy. So Larry transferred from Denver to the headquarters of the corporation, in Bethesda, Maryland, and assumed responsibility for the increasingly diverse operations of the aerospace company, including new and expanded research and development programs in microelectronics, materials, propulsion, guidance and control, software, robotics, and a variety of other advanced technologies.

By 1982, Larry had become executive vice president and COO of the corporation. But in August of that year, the Bendix Corporation, led by Bill Agee, decided to make an offer to acquire Martin Marietta. The corporation's battle to fight off Bendix is legendary in the business world. Larry became a member of the eight person team that the chairman of Martin Marietta, Tom Pownall, then put together to defend the corporation's independence. Larry's primary responsibility, however, was to keep the company running smoothly and efficiently, while the rest of Pownall's "A-Team," focused first on defense, and then on counterattacking Bendix using an approach now widely known as the Pac Man strategy which, in essence, involves endeavoring to take over the company that is trying to take you over.

Clearly, this requires having the resources to do so . . . and Larry was then called in to persuade certain financial houses that this would be a good investment. William Harwood describes this situation beautifully as follows: “If you were casting in Hollywood, you couldn’t find a more convincing model of a corporate chief operating officer than the silver-haired, square-jawed Adams. His straight-arrow, deliberate approach conveyed the confidence the bankers were looking for; obviously, there was a firm hand on the day- to- day control of Martin Marietta’s businesses.”

After the Bendix confrontation, Larry was promoted to president and COO of the corporation and, working with Pownall and other senior staff, helped the company to divest most of its commercial operations, and to refocus its energy on its roots in aerospace, electronics and information systems, thereby setting in place the basis for its current reputation as a world leader in these areas of technology.

1n 1986, Larry Adams retired from Martin Marietta, and began a very active second career as a technical and management consultant . . . and philanthropist.

His first consulting assignment was a portent of things to come . . . he was appointed to the committee to determine the cause of the Challenger disaster and to redesign the boosters used in the Space Shuttle program. He remarked later that this was the most difficult task with which he had ever been involved. However, over the next twenty years, as a member of the Air Force Scientific Advisory Board, he served on panels dealing with such issues as space power, hypersonic vehicles, and electronic combat systems. He also served on National Research Council committees concerned with space policy and transportation systems. He was chair of the Committee on Small Spacecraft Technology and of the Committee on the Global Positioning Satellite system . . . the committee that recommended elimination of some of the security features that degraded non-military uses . . . a recommendation that has permitted the now widespread use of GPS-based automobile navigation systems. He also was a member of the NASA Advisory Council and Space Station Advisory Committee, and of the U.S. Information Agency's committee to review the design of its worldwide shortwave radio broadcasting system. And the list goes on and on.

Over the course of his long career, Larry received numerous honors. Among them, he was elected president and Fellow of the American Institute of Aeronautics and Astronautics, and was a three time recipient of NASA's Public Service Medal for his contributions to the Viking Mars Lander Program, the Titan Centaur Launch Vehicle, and the Titan III program. He served as Chairman of the Board of Trustees of the National Security Industrial Association, of the National Conference on the Strategic Management of Research and Development, and of the Challenger Center for Space Science Education.

Larry was very much aware of the difficulties that developmentally disabled persons have in finding meaningful work in a supportive environment. This concern led to his fifteen year involvement with the work of Western Maryland College in this area, and specifically with the graduate program on Human Service Management that focuses on the developmentally disabled. Larry became a trustee of the college (now known as McDaniel College) in 1989, and in 1992 the College established the Laurence J. Adams Chair in Special Education for graduate students. In 1993, he was the very proud recipient of an honorary Doctorate in Humane Letters from the college.

A devoted family man, Larry was the father of two sons and three daughters. Wife Peggy says that, despite his many other responsibilities, he was never too tired to listen and to offer positive advice. In his later years, he considered his seven grandchildren to be his "greatest jewels." And, for relaxation, he was for many years an enthusiastic supporter of the Baltimore Orioles.

When speaking with friends about Larry Adams, the word "gentleman" always enters the conversation, for Larry was a gentleman in every positive connotation of that word. He was also a great leader . . . and to be such, others must be willing to follow. For those of us so blessed, to follow Larry was a pleasure, a privilege, and an adventure.

Larry Adams is survived by his wife, Marguerite "Peggy" Adams of Potomac, Maryland; five children, Stephen Adams of Aurora, Colorado; Michael Adams of Potomac, Maryland; Mary Louis Sterge of Malvern, Pennsylvania; Teresa Hayes of Collegeville, Pennsylvania; Susan Adams of Gaithersburg, Maryland; and seven grandchildren.

OLIVER C. BOILEAU

1927–2007

Elected in 1979

"For contributions to the technical and cost management of major aerospace programs and to national defense."

BY KENT KRESA

OLIVER C. BOILEAU, a retired senior aerospace executive, died on July 27, 2007, at the age of 80. Mr. Boileau, known as Ollie, was a critical participant in some of America's most important and challenging defense and space programs. He held top leadership positions at the Boeing Company, General Dynamics Corporation, and Northrop Grumman Corporation. He was elected to the National Academy of Engineering in 1979 for "contributions to the technical and cost management of major aerospace programs and to national defense."

Born in Camden, New Jersey, on March 31, 1927, Ollie grew up and went to school in that state. A good student with a strong interest in technical subjects, he soon set his sights on becoming an engineer. After graduating high school, eager to serve his country, Ollie joined the U.S. Navy. He finished at the top of his class in a Navy electronics training program, and after specializing in shipboard communication, he became a petty officer while still in his teens. He later considered this early leadership experience, and his service in Japan, valuable extensions of his education.

In June 1946, he returned to New Jersey, where he met his future wife, Nan Eleze Lee. The couple were married in 1951, the beginning of a lifelong union; they subsequently had two sons, two daughters, and two grandchildren.

After the war, Ollie attended the University of Pennsylvania, where he received a B.S. in 1951 and an M.S. in electrical engineering in 1953. In 1964, as a Sloan Fellow at the Massachusetts Institute of Technology (MIT), he earned an M.S. in industrial management.

Ollie began his industrial career in 1951 at the RCA Corporation in Camden, working on aircraft electronics. In 1953, he joined the Boeing Company in Seattle as a research engineer. He progressed rapidly through the technical and management ranks at Boeing, where he directed work on major programs. In 1968, he was named a vice president, and in 1973 he was promoted to president of Boeing Aerospace Company, the corporation's military and space arm.

In 1980, Ollie left Boeing to become president and a member of the Board of Directors of General Dynamics Corporation, in St. Louis. In January 1988, he was promoted to vice chair of the board. He retired from General Dynamics in May 1988.

In 1989, he joined Northrop in southern California, where he headed the company's work on the B-2 stealth bomber for the U.S. Air Force. In 1994, when Northrop acquired some of Grumman Corporation's operations, Ollie became head of that division, as well as vice president and a board member of Northrop Grumman Corporation. He retired on January 29, 1995.

Ollie was a member of the Defense Science Board of the U.S. Department of Defense, the Scientific Advisory Group of the Joint Strategic Target Planning Staff, and the Energy Research Advisory Board of the U.S. Department of Energy. He was also a fellow of the American Institute of Aeronautics and Astronautics, a trustee and member of the Association of the U.S. Army, and a member of the Air Force Association, the Navy League of the United States, and other associations.

Ollie was chairman of the MIT Lincoln Laboratory Advisory Board, a member of the Board of Trustees of St. Louis University, and a member of visiting boards for MIT, University of Pennsylvania, and Southern Methodist University.

During his long career, Ollie was instrumental in many high-profile defense and space ventures. As a Boeing engineer and manager, he was a leader in the development of the solid fuel-propelled Minuteman ICBM, which had been designated the "highest national priority." He also led a Boeing team assigned to revamp the Lunar Rover Project, and eventually, the Lunar Rover performed brilliantly on the Moon.

Later, at General Dynamics, Ollie rescued the faltering M-1 Abrams tank program, which had been acquired as part of Chrysler's defense operations. Under his leadership, performance of the tank was greatly improved, and congressional confidence in the system was restored. The M-1 subsequently became a critical element of the company's business.

When Ollie joined Northrop in the late 1980s, the B-2 division faced the formidable tasks of simultaneously completing a development flight-test program, building low-rate initial production vehicles, and fielding the first block of operational vehicles. The assignment was complicated, not only by the challenges of developing and testing these revolutionary technologies, but also because the division was relatively new—as were the program's relationships with Northrop, Boeing, Vought, GE, and Hughes, not to mention relationships with new customers. Overall, Ollie confronted a systems-integration mission comparable in some respects to those of the Manhattan Project.

Ollie first focused his efforts on building his team, introducing the systematic rigor and discipline he expected to be implemented throughout the program. He was the ultimate taskmaster, and "Ollieisms" quickly became legend. The B-2 program comprised an incredible mix of talented people from across the country, but Ollie was able to instill a cultural identity in this "melting pot." He did this by creating "boot camp style" seminars for the high-potential managers focused on systems engineering, program management, and major subcontract management. He also "empowered" the industry partners by strengthening ties and improving communications among key corporations.

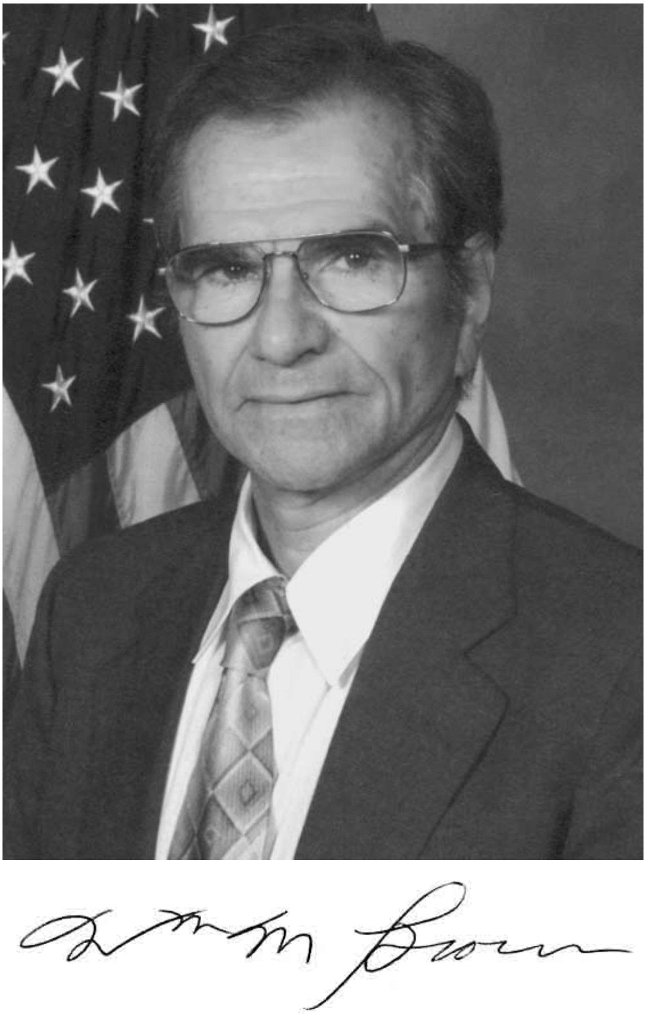
But most important, he taught, he taught, and he taught. He would talk to a technician working on the airplane and ask to be shown the command media or the drawing tree that authorized the work. Or he would sit in a tank-sealing course to see if he could do the task himself after being trained. His message was clear—get involved in the details, demand rigor and discipline in all processes, configuration-control systems, and scheduling and cost-management systems, and then follow up to ensure they are implemented.

Despite the numerous locations and constituencies involved in this massive undertaking, Ollie gradually instilled a dedication to collaborative action and created the common tools and techniques to meet performance goals and achieve success. The foundation he built for the B-2 program is still relied on today.

Ollie's expertise in and fascination with the enterprise of engineering were the foundations of his skills as a leader. In 2001, speaking at the commencement ceremony of the University of Pennsylvania School of Engineering, he marveled at today's technologies and noted how far and fast engineering had advanced since the day, 60 years ago, when ENIAC, the first electronic computer, was invented at Penn, and how many new avenues for exploration are open to graduating engineers today.

Despite these great leaps forward, he told the students, one thing about engineering never changes. "The most fulfilling experience is still to create something through teamwork."

He is survived by his wife, Nan Eleze (Lee) Boileau; two daughters; two sons; and two grandchildren.



WILLIAM M. BROWN

1932–2008

Elected in 1992

"For leadership and contributions to the theory and practice of synthetic aperture radar."

BY (FLOYD) PAUL JOHNSON AND ED ZELNIO
SUBMITTED BY THE NAE HOME SECRETARY

WILLIAM M. BROWN, perhaps best known as the founder and president of the Environmental Research Institute of Michigan (ERIM), died on February 23, 2008, at the age of 76, after a long career dedicated to the nation's defense. He became an NAE member in 1992 for his work on linear systems analysis, random processes, and fine resolution radar.

"Bill," as he was known to friends, family, and colleagues, was raised in Wheeling, West Virginia, the youngest of four children of John David Brown and Marjorie Jenny Walters. He had a great love for mathematics, which became apparent at Triadelphia High School in Wheeling, where his math score on the college entrance exam was the highest in three states. This early evidence of his brilliance coupled with his homegrown values continued to serve him and this nation well.

Bill enrolled at West Virginia University at the age of 17 and finished first in his class two and one half years later. He continued his education at The Johns Hopkins University where he received his M.S.E.E. in 1955.

Bill began his defense work at Westinghouse, Baltimore, while working on his D. Eng. at The Johns Hopkins University. He received his D.Eng. in electrical engineering in 1957. Subsequently, he studied sensor systems at the Institute for Defense Analysis at the Pentagon. This experience opened his eyes to the untapped potential of sensing systems, which, in turn, set him off on a storied career advancing the state of the art in sensing and applying these advances to defense and civilian systems.

In 1958, Bill joined the engineering faculty at the University of Michigan (UM) where he headed the radar laboratories. During this time, he authored graduate-level texts based on his work in remote sensing: *Analysis of Linear Time-Invariant Systems* (McGraw-Hill, 1963), and with Carman J. Palermo, *Random Processes, Communications, and Radar* (McGraw-Hill, 1969). He was elected full professor in 1963 at the age of 31.

In 1970, Bill became director of the UM Willow Run Laboratories, which were conducting vitally important research for the U.S. Department of Defense. However, with the advent of the Vietnam War and student unrest at UM over the research at Willow Run, in 1972, Bill spearheaded the formation of ERIM, a not-for-profit successor organization to Willow Run Laboratories. The transition was a testament to Bill's dedication to the importance of the defense mission of Willow Run and to his ingenuity in navigating federal, state, and university minefields to succeed in this historic achievement.

Bill served as president of ERIM, which grew from an institute with 400 employees and an initial $4 million annual budget to 850 employees and an annual budget of $85 million. This growth, however, was a side effect of Bill and ERIM's more important contributions—revolutionary sensor inventions and their novel applications to defense missions. During these exciting times, ERIM innovated and demonstrated advances in synthetic-aperture radar (SAR) leading to practical high-resolution imaging systems from very long ranges. They invented and transitioned systems in 3D imaging using laser radar and interferometric SAR. They were also involved in the exploitation of these sensor systems and significantly contributed to massively parallel implementations of algorithms based on image morphology. For each of these significant technical contributions, Bill had been at the chalkboard hashing out new concepts, marketing ideas to customers, and finally guiding them into reality.

After retiring from ERIM in 1994, Bill shared his gifts with one of his most valued customers, the U.S. Air Force, first as head of the Electrical and Computer Engineering at the Air Force Institute of Technology (AFIT), located at Wright Patterson Air Force Base in Dayton, Ohio, and subsequently as chief scientist of the Sensors Directorate of the U.S. Air Force Research Laboratory (AFRL), where he continued to work on SAR, laser radar, and automatic target-recognition technologies until his retirement in 2006. Both AFIT and AFRL deeply appreciated the magnitude of his contributions to our nation's defense and his keen intellect and experience, as he continued to work out revolutionary ideas on the chalkboard that will guide sensor development for years to come.

Bill Brown was the recipient of numerous awards, including the Aviation Week Smithsonian Air and Space Museum Laureate Award, the IEEE AESS Pioneer Award, and the Military Sensing Symposia's Thomas B. Dowd Award. He was an NAE member and an IEEE fellow. His citation read: "For contributions to linear systems analysis, random processes, and fine resolution radar."

Bill served as the radar editor of the IEEE Transactions on Aerospace and Electronic Systems from its inception in 1965 to 1974 and as editor in chief until 1987. He was a member of many national-level panels, including the Army Science Board and Air Force Scientific Advisory Board, and was chairman of the board for the International Symposium on Remote Sensing of the Environment.

Bill's energy, dedication, and enthusiasm were not confined to his professional life. He was an avid skier, bicyclist, swimmer, and runner, competing in numerous marathons — including the Boston, and triathlons — including a 2nd place win for his age group in an iron man. He also loved music, particularly Broadway shows, and was even known to break into song from time to time, entertaining his friends and relatives with a medley of show tunes.

The passion and integrity that characterized his career were applied in equal measure in Bill's family life. He was a devoted husband to his wife, Norma, and their marriage was a source of great joy and strength to him for 45 years. A trusted friend and mentor to his three children, Cheryl, Mark, and Jennifer, he taught them the importance of honesty, humility, decency, and fair play by demonstrating these qualities every day in his life. "Don't say you're coming, be there," he would tell them on occasion. And he always was.

As Bill reflected on his life, he noted that he never got out of bed in the morning without first deciding what challenge he would attack that day. He was brilliant and dedicated, yet always willing to share his wisdom and time with anyone who sought his advice. The following tribute by Charles M. Vest, president of the National Academy of Engineering, reflects the respect and feelings of all who had the honor of working with Bill.

> Bill's contributions to the field of remote sensing are unique in their impact and breadth. He developed and served in this field of endeavor as a scientist, engineer, teacher, administrator, entrepreneur, and counselor. He advanced the state of the art in many dimensions over multiple technological generations. He single-handedly established ERIM and built it into a research organization of first rank. He served pressing needs in the defense sector and led the effort to transfer remote sensing technology from military to civilian applications.
>
> The importance of the early technical work he led and the catalytic nature of the international community he built through symposia and organizations would be difficult to overstate. The span and complexity of Bill's contribution to remote sensing were made possible by his unusually strong intellect and his concentration on forming a philosophical basis for the development of both systems and organizations. The effective way in which he formulated and attained his vision both as a scientist/engineer, and as the leader of a major research institute, speak to his integrity and ingenuity.

Bill is remembered by his loving wife, Norma Hulett Brown; his children, Cheryl Lynn Brown, Mark William Brown, and Jennifer Christine Brown; his grandchildren, William Fryberger, Katherine Brown, Allison Brown, Gordon Brown and Alexander Brown; his great grandchildren, James Fryberger and Mary Jane Fryberger; his brother, John Brown and his sister, Mary Ellen Harmon.


NCA

SIR ARTHUR CHARLES CLARKE

1917–2008

Elected in 1986

"For conception of geosynchronous communications satellites, and for other contributions to the use and understanding of space."

BY HANS MARK

SIR ARTHUR CHARLES CLARKE died on March 19, 2008, at this home near Colombo, Sri Lanka, at the age of 90. He was elected a foreign associate of NAE in 1986.

Sir Arthur, the first of four children, was born in Minehead in southern England on December 16, 1917. His father was a farmer and his mother a post office telegrapher. Early on, he developed an interest in science and technology, especially astronomy, and while still in grammar school, he built a telescope to "map the Moon." At age 13, young Arthur discovered science fiction and became a voracious reader of stories of space exploration and life on other planets in the very popular "pulp" magazines. Thus the interests that would shape his life took hold in his mind when he was still very young.

Arthur attended a private school in Taunton on a scholarship from 1927 to 1936. Upon graduation, he secured a position as an auditor in the Department of the Exchequer. In 1941, he joined the Royal Air Force. As a technical officer, he was a member of the very successful British-American team working on the early ground-controlled approach (GCA) radar system being developed by people at MIT. Arthur was demobilized with the rank of flight lieutenant in 1945. He then enrolled at King's College of the University of London, and in 1948, he received a Bachelor of Science degree with first-class honors in physics and mathematics.

I first ran across the name of Arthur Clarke in 1947 when I was a senior at Stuyvesant High School in New York City. My early interests were also oriented toward space exploration, and I had acquired a book by the German author Willy Ley entitled *Rockets and Space Travel: The Future of Flight Beyond the Stratosphere* (Viking Press, 1947). A passage on page 296 cites a "recent and most interesting suggestion advanced by Arthur C. Clarke of the British Interplanetary Society." More than 60 years ago, I underlined this passage and the sentence that followed: "In an article published in "Wireless World" in the October 1945 issue he advocated a system of three space stations revolving in the same orbit (and forming a triangle with the Earth at its center) for worldwide radio and television coverage." This was an audacious idea, and I remember wondering if I would be alive when Clarke's proposal was implemented. But it happened long before I expected.

In another article published in 1947, Clarke predicted that nuclear-powered rockets would be developed "within 20 years." (Unfortunately, I cannot find the reference, but later, when I met him, he confirmed that he had said this.) So Arthur was not infallible as a technological prophet.

In 1948, Arthur Clarke made the decision to become a professional writer, and he published his first science fiction novel, *Against the Fall of Night,* in 1953. In 1956, he moved to Sri Lanka (Ceylon at the time), where he resided, near Colombo, for the remainder of his life, although he continued to travel widely and spent extended periods of time abroad. In 1963, he published his only non-science fiction novel, *Glide Path,* which is based on his work on radar during World War II. This was the beginning of his great productive period.

Arthur's collaboration with Stanley Kubrick began in 1964 and led to the memorable film, *2001: A Space Odyssey,* released in 1968. The movie was an example of Arthur's unique talent.

He had a first-class technical intelligence, and all of his books were somehow plausible; he also had a superb imagination. The high quality and popularity of his books were based on a combination of these elements. In *2001: A Space Odyssey*, the imaginative idea was that a computer, HAL, would try to take over the spaceship. The story was a cliffhanger until HAL was finally bested.

My personal favorite among Arthur's writings is *Rendezvous with Rama* (Harcourt Brace Jovanocvich, 1973). In this book, Arthur's imagination takes the lead. After an asteroid collides with the Earth causing catastrophic damage, a group of people decide to leave. They build a huge spaceship to accomplish their objective. The gripping story also involves imagining something completely new at the time—a group of humans leaving the Earth forever. Arthur's book describes the consequences.

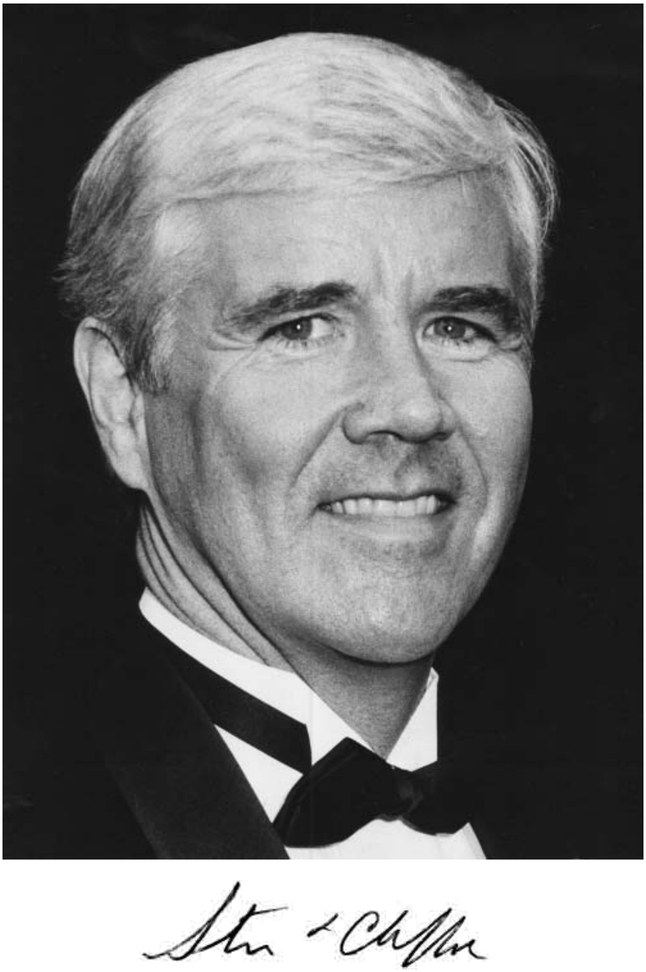
During the years I spent in Washington (1977–1984), I met Arthur Clarke several times. He would visit NASA Headquarters, and we would arrange discussion sessions, which were always unique experiences for those of us who attended. Following those sessions, we would take Arthur out to dinner. During one such party, I remember discussing Clarke's law: "Any sufficiently advanced technology is indistinguishable from magic." Someone added that it must also violate the "principle of least astonishment," which we decided was a good general principle related to magic! We also added some other laws, which were adopted by consensus. My favorite was: "If an old, distinguished scientist or engineer tells you something cannot be done, he is probably wrong." Arthur had a good sense of humor, and he always enjoyed these visits.

Arthur Clarke's achievements were widely recognized, and he received many honors. The most important was nomination for a Nobel Peace Prize in 1994, probably based on his long-standing advocacy of international collaboration in space exploration as "an alternative to armed conflict." In 1998, he was knighted by Queen Elizabeth II for his contributions to literature. Arthur's achievements were also honored in the

United States, where he was elected a foreign associate of the National Academy of Engineering in 1986 and awarded NASA's Distinguished Public Service Medal in 1995.

For all of his fame and notoriety, Arthur Clarke was a private person who loved his life in Sri Lanka. He was an expert ping-pong player, and he loved scuba diving. He married Marilyn Mayfield in 1953, but the marriage was dissolved in 1964. Arthur never had any children.

Arthur Clarke was one of the most influential people in the last half of the twentieth century. His legacy is the books he wrote and the ideas they contain. I consider it a great privilege to have known him. I miss him and mourn his passing.



STEVEN F. CLIFFORD

1943–2007

Elected in 1997

"For contributions to the understanding of electromagnetic and acoustic propagation in random media, leading to the development of new sensing techniques."

BY RICHARD G. STRAUCH

STEVEN F. CLIFFORD, Research Scientist Emeritus, University of Colorado Cooperative Institute for Research in Environmental Sciences (CIRES), died on September 18, 2007, at the age of 64. He was the former director of the National Oceanic and Atmospheric Administration (NOAA) Environmental Technology Laboratory (ETL) and a distinguished scientist in the field of electromagnetic and acoustic wave propagation in random media. He was elected to the NAE in 1997.

Steve was born in Boston, Massachusetts, on January 4, 1943. He graduated from Boston College High School, and in 1965 he received a B.S. in electrical engineering from Northeastern University. He received his Ph.D. in engineering science (theoretical physics) from Dartmouth College in 1969. His dissertation, "Wave Propagation in a Turbulent Medium," written under the supervision of Professor John Strohbehm, marked his entrance into the field in which he would earn his scientific credentials and an international reputation.

Steve began his career in 1969 as a National Science Foundation postdoctoral research associate with the Wave Propagation Laboratory (WPL) of the Environmental Science Services Administration, the precursor of NOAA. For more than three decades he published widely on topics related to the physics of wave propagation and scattering in random media and the remote sensing of the atmosphere and oceans. Five of his publications received NOAA's Outstanding Paper Award.

His publications on theoretical subjects and their applications to ground-based remote-sensing techniques and instrumentation numbered more than 130 and appeared in optical, acoustic, and radio journals. They include work on optical scintillation that led to laser wind-measurement devices and laser weather identifiers; the development of the theoretical limitations for Radio Acoustic Sounding Systems (RASS) that led to the implementation of RASS on radar wind profilers; studies of acoustic propagation in the ocean and acoustic scintillation that led to ocean current measurement instrumentation; and work in atmospheric acoustics that contributed to the understanding and interpretation of acoustic echo sounder records. His three patents relate to applications of propagation in turbulent media to acoustic and optical remote sensors.

From 1969 to 1982, he was a physicist with WPL, and from 1982 to 1986, he was chief of the Propagation Studies Program Area in WPL. In 1986, he succeeded C. Gordon Little, founding director of WPL; he was director of ETL (formerly WPL) until his retirement from NOAA in 2001. He was appointed Research Scientist Emeritus at CIRES in 2001.

The breadth and depth of Steve's scientific achievements earned him many honors and awards. He was elected a fellow of the Optical Society of America at age 31, a fellow of the Acoustical Society of America at age 40, and an NAE member at age 54. He was also a Senior Member of IEEE and a member of the American Physical Society, American Meteorological Society, and American Geophysical Union.

Steve was a 1986 graduate of the Program for Senior Managers in Government at the Harvard University John F. Kennedy School of Government. In 1998, he received the Meritorious Presidential Rank Award for exceptional long-term service as a senior executive. In January 2000, he was appointed to the National Research Council/National Academy of Sciences (NRC/NAS) Board on Atmospheric Sciences and Climate (BASC), and he was chair of the NRC/NAS workshop on Weather Forecasting Accuracy for Federal Aviation Administration Traffic Flow Management, a member of the

NRC/NAS Panel on Tools for Tracking Chemical/Biological/Nuclear Releases in the Atmosphere, and a member of the NRC/NAS Committee on Future Directions in Weather Modification Research.

In 1989, he led the first American delegation to visit the closed city of Tomsk, Siberia, and he organized exchange agreements with the Institute of Atmospheric Optics in Tomsk, the Main Geophysical Observatory in Leningrad, and the Institute for Atmospheric Physics in Moscow. He was particularly gratified when, through his efforts, a team of scientists headed by Academician Valeryan Tatarskii relocated to Boulder, Colorado, to collaborate with ETL scientists on fundamental studies of propagation and scattering phenomena.

Sports were always an integral part of Steve's life. As a younger man, he excelled at baseball and enjoyed basketball and skiing. As many colleagues can attest, he remained a formidable opponent at the dart board. As years passed and he no longer actively participated in team sports, he continued to be an enthusiastic fan of his favorite teams. He was also an avid world traveler and crossword puzzler.

Steve Clifford had a profound influence upon, and was integral to the success of many family members, friends, and colleagues. A brilliant mentor in all areas of life and a perfect companion to his wife Terri, he will be missed immensely. His brilliant mind, sense of humor, work ethic, gentle and unassuming manner, and kindness will live on in the memories of everyone who knew him. He will be remembered by all as a significant and wonderful person in their lives.

Steven is survived by his wife, Theresa Kavanagh (Terri), children, Cheryl Clifford Rapoza (Jim), of Weymouth, Massachusetts; David Clifford (Elisabeth), of Los Angeles, California; Michelle Clifford, (Bill Held), of Boulder, Colorado; grandchildren, Zachary, 4, and Alyssa, 2; and stepchildren, Alison Collins of Boulder and Kristopher Collins of Denver. Steven will also be remembered by his brother, Robert Clifford and his wife Betsy of Hingham, Massachusetts; his 92 year old father, J. Nelson Clifford, who resides in San Diego, California; and his former wife, Jane Parks, of Thornton, Colorado. He was preceded in death by his mother, M. Dorothy Clifford, in 1998.

C. ALLIN CORNELL

1938–2007

Elected in 1981

"For development of practical methods for application of probability to structural and earthquake engineering."

BY ROBIN K. MCGUIRE, ROSS B. COROTIS, AND
GREGORY B. BAECHER

C. ALLIN CORNELL, who died on December 14, 2007, at the age of 69, was an early proponent of using quantitative probability methods to define structural reliability and safety and, more importantly, using those concepts to make rational engineering decisions. His work had a fundamental impact on building codes and standards of practice in the design and retrofitting of structures to withstand earthquakes (commercial buildings, dams, bridges, and power plants), strong winds and waves (offshore oil platforms), and hurricanes (commercial and residential buildings). He was elected to the National Academy of Engineering in 1981, at the age of 42, for the "development of practical methods for application of probability to structural and earthquake engineering."

Born in Mobridge, South Dakota, in 1938, Allin received an A.B. in architecture and an M.S. and Ph.D. in civil engineering, all from Stanford University. His dissertation, "Stochastic Process Models in Structural Engineering," and his 1971 book (co-authored with Jack Benjamin), *Probability, Statistics, and Decision for Civil Engineers* (McGraw-Hill), laid the foundation for his lifelong interest in using stochastic models to represent environmental loads on structures and determine structural responses to those loads. His book is still a standard reference for students and researchers, and its title reflects Allin's conviction that structural reliability and safety are not abstract concepts but practical applications that must be used to improve engineering decisions.

In 1964, Allin became a Ford Foundation Fellow at the Massachusetts Institute of Technology (MIT), where he joined the regular faculty in 1966. Since then, his hundreds of papers have defined the field of structural reliability and safety. His early papers on first-order, second-moment concepts established the field of probability-based codified structural design. As a result of his research on structural reliability and safety techniques, he was the inaugural recipient in 1987 of the CERRA Award from the International Civil Engineering Risk and Reliability Association. The American Society of Civil Engineers presented him with the Moisseiff Award (1977), Norman Medal (1983), and Fruedenthal Medal (1988) in recognition of his research contributions to solving structural-reliability problems in civil engineering.

In 1983, Allin moved back to Stanford as Research Professor, a half-time commitment that gave him time to pursue consulting. With this arrangement, his consulting advice benefited from his research results, and his research directions and interests were guided by the problems faced by practicing engineers and earth scientists. Through his collaboration with industry, Allin developed a basis for the probabilistic design of drilling and exploration platforms and was a strong advocate for ensuring the structural reliability of offshore structures. He also made significant contributions to "risk-informed" decision making for nuclear power plants (the application of probabilistic descriptions of environmental loads).

In addition to reliability and safety problems that could be addressed purely with engineering applications, Allin had a keen interest in the earth sciences and in the applications of reliability and safety concepts to earthquake design. His seminal paper, "Engineering Seismic Risk Analysis," published in 1968 in the *Bulletin of the Seismological Society,* is often cited as a foundational document for the field of probabilistic seismic-hazard analysis. In this paper, Allin argued that optimal engineering decisions on seismic design or retrofitting had to begin with the rupture on the fault that released crustal-strain energy rather than with the earthquake ground motion at the foundation of a structure. This paper was the basis for the first seismic-hazard map in the United States that used probability theory; the map was published by the U.S. Geological Survey in 1976.

As he pursued these ideas, Allin came into contact with many earth scientists as well as earthquake engineers. From 1986 to 1987, he was president of the Seismological Society of America, which awarded him the Harry Fielding Reid Medal (its highest honor) in 2001. He was elected a fellow of the American Geophysical Union in 2002, an honor accorded to only a handful of engineers over the years. On the engineering side, he was the Distinguished Lecturer of the Earthquake Engineering Research Institute in 1999 and recipient of the Housner Medal (its highest honor) in 2003.

With his brilliant analytical mind, Allin often expressed profound impatience with anyone who used fuzzy terms or took liberties with precise mathematical definitions or equations. For example, in a 2005 paper describing the advantages of mean seismic-hazard calculations, he included an addendum with a correct, precise definition of the term "mean frequency," and he described how the term was often misunderstood or misused in the technical literature. Allin was always more concerned with technical accuracy than with brevity, to the consternation and disapproval of many technical editors. Allin's draft manuscripts often included parenthetical comments with qualifications or exceptions to statements in the text. A colleague once observed that his parenthetical remarks contained more technical insight than the main theses of many papers.

The terms "aleatory uncertainty" and "epistemic uncertainty" are good examples of the importance Allin placed on using precise terms in a precise way. Many of us initially objected to the use of these terms on the grounds that they were more cumbersome than the commonly used "randomness" and "uncertainty." Allin's rejoinder was, "Those common terms have been used so imprecisely and interchangeably in the past that they are useless. If we adopt two completely new terms with precise definitions, people will have to use them correctly." Aleatory uncertainty and epistemic uncertainty are now standard terms in both earthquake engineering and the earth sciences, a tribute to Allin's vision and persistence. Uninterested in cleverness for its own sake, he was determined that intellectual laziness not be allowed to limit the usefulness of the tools of probability by reducing precise calculations to fuzzy intuition.

Throughout his career, Allin was careful to give his colleagues proper credit for their work. For example, in 2007 he documented his collaboration in the 1960s with Luis Esteva from UNAM in Mexico, who contributed the earthquake-occurrence and ground-motion models that were integral to probabilistic seismic-hazard analysis. Allin's contribution was to integrate those models in a probabilistic format to obtain unbiased estimates of what is now called "seismic hazard," but he was insistent that Esteva's contributions be properly recognized. When he published technical papers co-authored by graduate students, Allin preferred to list the students' names first.

Throughout his professional career of almost 45 years, Allin was a mentor, colleague, and friend to many engineers and earth scientists. From the highest levels of government to his first-year graduate students, he advised us all with the same even, informative style. Those of us who knew him as a graduate advisor found him to be a tough but fair critic who would accept only our best efforts in developing and documenting our research. Our careers have been better for this constant reminder that the details of our work matter and for the gift of his friendship and humor.

Allin is survived by his wife, Elisabeth Paté-Cornell, Professor and Chair of Management Science and Engineering at Stanford, with similar research interests, and their two children, Phillip and Ariane Cornell; and three children from an earlier marriage, Eric Cornell, Robert Cornell, and Joan Fazzio. He is also survived by two sisters, Joan Scheel of Santa Rosa, California, and Bonnie Bassinger of Edna, Minnesota.


Jacob H. Douma

JACOB HENRICK DOUMA

1912–2004

Elected in 1971

"For contributions, as a hydraulic engineer and consultant, to federal and private practice here and abroad."

BY MARTIN REUSS
SUBMITTED BY THE NAE HOME SECRETARY

AFTER 34 YEARS of distinguished government service, mostly with the U.S. Army Corps of Engineers, Jacob (Jake) H. Douma emerged as one of the preeminent hydraulic engineers in the world. He was chief of the Hydraulic Design Branch in the Corps of Engineers from 1961 to 1975 and then became chief of the combined Hydraulic and Hydrology Branch, a position he held until his retirement in 1979.

Douma made many contributions that improved and made more cost-efficient the federal water projects that now dot—and helped shape—the American landscape. He was influential in designing flood-control channels, dams, locks, navigation channels, and other water-control structures. He also encouraged the use of computer modeling and helped write numerous technical manuals that have become standard references. For many years after he retired from government service, he was a consultant on projects around the world. He died on October 4, 2004, at the age of 92.

Jake was born in Hanford, California, south of Fresno, on May 30, 1912, the son of Dutch immigrants. Jake grew up in California's "Inland Empire," where he irrigated alfalfa fields during his summer vacations. This backbreaking work involved periodically digging ditches to ensure that water ran to the right portion of the field. Determined to find a better way, Jake read about the Bureau of Reclamation's contributions to irrigation and decided to pursue engineering in college.

At the University of California, Berkeley, he excelled in his studies, was tapped for Tau Beta Pi, the Engineering Honor Society, and became president of the Berkeley chapter in the fall of his senior year. His principal mentors at Berkeley were Morrough O'Brien and Bernard Etchevary, his favorite professor, whose practical, project-oriented approach he found particularly appealing. In 1935, after five years of study, he graduated, *cum laude,* with a B.S. in civil engineering and a focus on hydraulics and irrigation.

Jake applied for a job working on dams and irrigation projects for the Tennessee Valley Authority (TVA) and the Army Corps of Engineers Waterways Experiment Station (WES), a newly established hydraulic laboratory at Vicksburg, Mississippi. WES offered five dollars more a month than TVA, so he ended up in Vicksburg, where he learned that recent changes in pay scales would raise his monthly paycheck another 15 dollars—to $120. His first job was reading water gauges on a three-dimensional model of the lower 600 miles of the Mississippi River. He later became a research assistant working on model studies of Conchas Dam, a flood-control dam on the Canadian River in New Mexico.

He later accepted a job at the Bureau of Reclamation working on irrigation and hydropower studies in the Project Investigations Branch in Denver. However, he was soon bored with the work, which involved routine tabulation of rainfall and runoff records. He was more interested in the bureau's model studies of dams, canals, and various irrigation systems, and he eventually obtained work in the bureau's laboratory in Denver, where he helped develop model studies for Lahontan Dam in Nevada and the Boulder (Hoover) Dam tunnel spillway. While in

Denver, he also completed graduate courses in hydraulics and soil mechanics at Colorado State University.

Anxious to return to California and promised more pay, Jake took a job in the Los Angeles District of the Corps of Engineers in 1939. Almost immediately, he was loaned out to the Nashville District to assist in the design of Wolf Creek Dam in Tennessee, which was similar to Conchas Dam. After three months, he returned to Los Angeles, where he worked in the hydraulic design section. After about a year he became section chief and oversaw the design of numerous debris and flood-control dams and channels, including the San Gabriel River channel and Prado Dam.

One of his most important innovations was the application of high-speed highway design to high-velocity flood-control channels to create spiral transitions between straight sections and curves like the ones in professional race tracks or toboggan runs. The design was first used in a water project in the Tujunga Wash Flood Channel.

In December 1946, Jake moved to the Office of the Chief of Engineers in Washington, D.C., where he spent the rest of his government career. His main task was to review hydraulic-design reports prepared in Corps subordinate offices. He also worked in the Structural Branch of the Civil Works Directorate, where he raised the Corps' awareness of the consequences of poorly designed concrete structures susceptible to cavitation erosion resulting from high-velocity flows. He participated in the model testing of many major dams, including Oahe, Fort Randall, and Garrison on the Missouri River; McNary on the Columbia River; and several locks and dams on the Ohio River. He also led efforts to develop design-criteria charts and manuals, many of which were soon in widespread use beyond the Corps of Engineers.

In 1961, Jake became chief of the Hydraulic Design Branch in the Engineering Division of the Corps of Engineers Headquarters. In 1975, he became chief of the new combined Hydraulics Design and Hydrology Branch. He was also representative of the Chief of Engineers on the Committee on Tidal Hydraulics, which he helped establish in 1947, and the

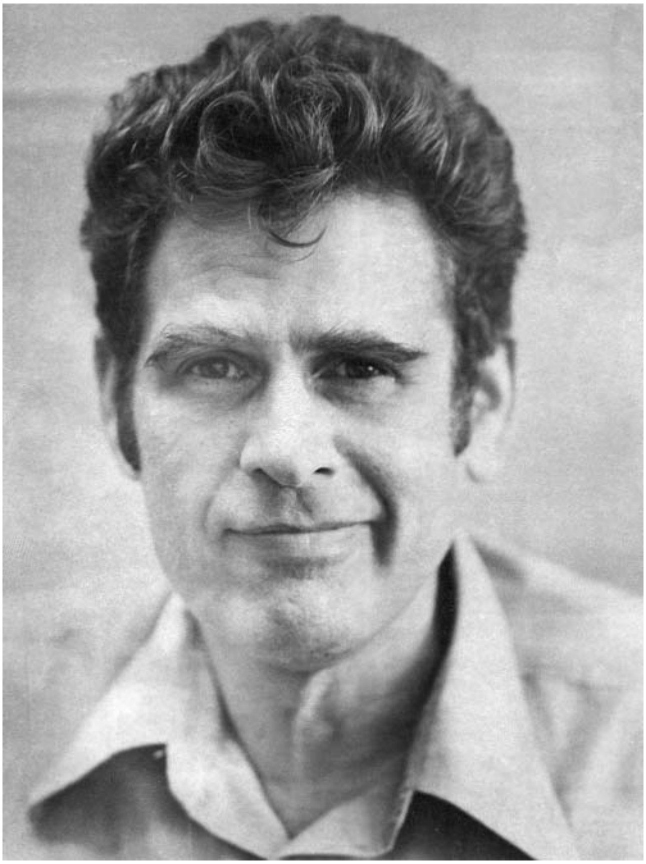
Committee on Channel Stabilization, which he proposed in 1965 and chaired until his retirement in 1979. He was also instrumental in developing a proposal for the Dredged Material Research Program (DMRP), which Congress authorized in 1970, to answer numerous questions about the impact of dredging on the environment.

Jake's expertise was recognized in his appointment as consultant on a large number of national and international water projects, including Guayaquil Harbor (Ecuador), Mactaquac Dam (Canada), Gull Island Dam (Canada), Tarbela Dam (Pakistan), and Reza Shah Kabir Dam (Iran). After retirement, he was consultant on Pardee Dam (California), Rafferty Dam (Canada), Susitna Dam (Alaska), and Horse Mesa Dam (Arizona). He was the author of 27 papers on multipurpose dams and flood-control channels and a contributor to *Handbook of Applied Hydraulics,* edited by V. Calvin Davis and K. Sorenson (1969) and a National Research Council report, *Safety of Existing Dams: Evaluation and Improvement* (1983).

Jake served on the U.S. Committees of the International Commission on Large Dams and the International Commission on Irrigation, Drainage, and Flood Control, as well as the Committee on Gates and Valves for Dams of the International Association for Hydraulic Research. He was a life member of the American Society of Civil Engineering and was elected a member of the National Academy of Engineering in 1971. In 1982 the Corps of Engineers named him to its Gallery of Distinguished Civilian Employees.

Jake's wife of 63 years, Allene Vartia Douma, died in 2002. He is survived by his sons, Allen Douma of Ashland, Oregon, and Mark Douma, and grandson, Jacob Mark Douma, both of Great Falls, Virginia.

His son remembers that his father really was born in a tarpaper shack by the side of the road. On a trip back to Hanford in 1998, he could point out the spot, but of course it wasn't there. At Berkeley, he earned money by being a waiter in a college girls boarding school. His parents spoke Dutch at home, so he had to take "bonehead" English to improve his proficiency. He got a "C" in railroad engineering, but otherwise did well. His future wife was a spectator at a Bureau of Reclamation intramural basketball game in Denver. After moving to Washington, they bought land in Virginia to build a house, but only after checking the soil fertility. The land included a stream which provided irrigation water. The house was their own design, and he was the architect while she was the prime contractor. While his family lived in the basement of the unfinished house, he went to India for a conference on large dams, the first of many worldwide. He calculated that he covered 1.5 million miles in his travels. He never learned how to type, but eventually learned to write well.



PETER ELIAS

1923–2001

Elected in 1979

"For pioneering in the field of information theory and leadership in electrical engineering education."

BY ROBERT GALLAGER
SUBMITTED BY THE NAE HOME SECRETARY

PROFESSOR PETER ELIAS, probably the most important early researcher in Information Theory after Claude Shannon, died from Creutzfeld-Jacob disease at his Cambridge, Massachusetts home on December 7, 2001. His three children, Daniel, of Lincoln, Massachusetts; Paul, of Cambridge, Massachusetts; and Ellen Elias-Bursac, of Cambridge, Massachusetts, were with him. His wife, Marjorie (Forbes), predeceased him in 1993 after 43 years of marriage.

Pete was distinguished not only for his research but also for his leadership of the Electrical Engineering Department at the Massachusetts Institute of Technology (MIT) from 1960 to 1966, a crucial transition period when the emphasis changed from engineering practice to engineering science and when computer science was initially recognized as a central part of electrical engineering.

Among his many honors and awards, Pete was a fellow of IEEE, a charter fellow of the Association for Computing Machinery (ACM), and a fellow of the American Academy of Arts and Sciences. He was elected to the National Academy of Sciences in 1975 and the National Academy of Engineering in 1979. He received the Claude E. Shannon Award, the highest honor of the IEEE Information Theory Society in 1977, and the Hamming Award, a major medal of the IEEE, shortly before his death.

Pete was born on November 26, 1923, in New Brunswick, New Jersey, where his father was an engineer at the Thomas Edison Laboratory. After two years at Swarthmore College, Pete transferred to MIT, where he received an S.B. in management in 1944. After serving as an instructor for radio technicians in the U.S. Navy for the remainder of World War II, he attended Harvard University where he received a master's degree in computation.

While searching for a Ph.D. topic in 1948, Pete came upon Claude Shannon's just published masterpiece, "A Mathematical Theory of Communication," and was hooked for life by its intellectual power and beauty. From the beginning, he realized that information theory provided the proper conceptual basis for digital communication, but that practical utilization required much additional work.

After completing his Ph.D. thesis, Pete was appointed a Junior Fellow in the Harvard Society of Fellows and spent the next 3 years doing research on a wide variety of subjects. This included several pioneering papers on optical communication and some collaboration with Noam Chomsky on linguistic theory, but Pete's interests were increasingly directed toward information theory.

At the time, Bell Telephone Laboratories and MIT were the main centers of research on information theory, and Robert Fano at MIT persuaded Pete to become an assistant professor of electrical engineering at MIT in 1953. Information theory created a heady atmosphere of intellectual beauty and importance that attracted the very best graduate students at MIT, and the next seven years were extremely productive for Pete as well as for information theory and MIT

The cornerstone of Shannon's theory is an existence proof that data can be encoded to assure essentially error-free transmission over arbitrary noisy channels at any rate less than their capacity. It would take another 40 years to learn how to reach capacity in practice, but Pete's 1954 paper, "Error-Free Coding"[1] provided a major step in this evolution by developing

[1] Elias, P., "Error free coding," *Institute of Radio Engineers* (IRE) PGIT, 4.4:29-37, 1954.

the concepts of product codes and iterative decoding. The paper used these concepts to invent the first algorithm for achieving error freedom at a strictly positive tansmission rate.

Pete's paper "Coding for Noisy Channels"[2] was perhaps the most influential early information theory paper after Shannon's original work. This provided three giant steps toward the central problem of reliable coding and decoding over noisy channels (here restricted to the simple but easily generalized case of binary symmetric channels).

The first step was an upper bound on the probability of error, averaged over all codes of a given rate R and block length *n.* This was accompanied by a lower bound for the best code of given R and *n.* The upper and lower bounds were effectively the same and decreased exponentially in *n.* This showed that error probability is insensitive to code choice and that modest *n* could provide sufficient error freedom in practice.

The second step was to show that parity check codes (a class of codes that are particularly simple to implement) are just as effective as arbitrary codes. The third step was the invention of convolutional codes, accompanied by a proof that they are at least as effective as the block codes of all earlier research. The majority of current practical coding systems have evolved through the use of convolutional rather than block codes.

Other early papers that became classics were "Channel Capacity without Coding" and "List Decoding for Noisy Channels." In the first, Pete provided a concrete example of how the use of feedback can be used to greatly simplify transmission at capacity. The second illustrated how error probability can be reduced if the decoder can provide several possibilities rather than decoding to a single message. Both of these papers appear to be highly specialized, but have led to a number of significant later uses.

It was characteristic of Pete's best papers that many appeared in non-archival places allowing for rapid dissemination. This was an era where the field was small and collegial, and Pete was singularly uninterested in getting credit for his work.

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[2] Elias, P., IRE Convention Record 3.4: pp 37-46, 1955

Rather, he was interested in helping other researchers and being part of the research community. He set an excellent example for the graduate students of the time, and information theory has remained a highly collegial field. His classic papers have also been republished in anthologies.

In 1960, Pete was promoted to full professor and, at the same time, was appointed head of the Electrical Engineering Department. He was 37 at the time, a remarkably tender age to be appointed head of the largest department at MIT. He was chosen partly because of his widely recognized tact, good will, and integrity, and partly because he was central to the growth areas of the coming information age.

Pete's research was in high gear at the time and he was ideally situated to solve important fundamental research problems. Accepting the appointment meant putting his research on hold and leading a department of 72 faculty members, many older and more experienced than he. Pete was an academic and intellectual at heart, but he was also a generalist and humanist who enjoyed interacting with others and the challenge of helping an outstanding group of engineers working on a wide variety of important problems.

Despite his qualms, Pete accepted the appointment, and the department changed and prospered enormously over the next 6 years. His style of leadership was to help people develop their own ways of contributing, within the constraints on the department. As one of Pete's Ph.D. students at the time, I didn't realize what a gift it was to have a mentor who actively contributed, but also let me develop my own skills in formulating and doing research.

During Pete's tenure, the department grew by more than 50 percent, and research topics changed even more. At the beginning, the department had a dual focus on the processing and transmission of energy and the processing and transmission of information. By the end of his tenure in 1966, the information side, particularly computer science, had dwarfed the energy side.

In 1966, Pete returned to a more academic life of research and teaching. His research shifted somewhat toward computer science, particularly questions concerning storage, organization, and retrieval for large files. His papers in this area lay part of the groundwork for the later development of universal data compression algorithms.

Pete was also a senior statesman after 1966 and in considerable demand for government, MIT, and professional committees requiring people of wisdom and tact. Years later, he chaired the Ad hoc Committee on Family and Work at MIT. The report of this committee in 1990 is generally credited with a major improvement in the rules and sensitivities at MIT for balancing family needs and work pressures.

Pete became an emeritus professor in 1991. Although he was "retired," he still enjoyed coming to his office most days. He continued to advise students, organize department colloquia and participate in the intellectual life of the community until sickness overcame him. He was always a wonderful conversationalist, so well informed and well balanced that everyone just enjoyed talking to him. His many colleagues miss him greatly.

LLOYD EDWIN ELKINS, SR.

1912–2004

Elected in 1976

"For pioneering developments to increase oil and gas production from low-grade reservoirs."

BY HOSSEIN KAZEMI

LLOYD EDWIN ELKINS, SR. passed away at the age of 92 in his last residence in Amarillo, Texas, on December 17, 2004. He was known for "fathering" hydraulic fracturing, a technique used for oil and gas recovery worldwide.

Born in 1912 in Golden, Colorado, to Edwin and Beulah Elkins, Lloyd attended elementary school, high school in nearby Wheatridge, and the Colorado School of Mines (CSM) in Golden, where he was a member of the social fraternity Sigma Phi Epsilon and three honorary societies, Tau Beta Pi, Sigma Gamma Epsilon, and Scabbard and Blade. He was also a four-year letterman on the basketball team at CSM. In 1934, he received a degree in petroleum engineering from CSM. He later attended the Harvard School of Advanced Business Management (graduation in 1948), and in 1963, he received an honorary doctorate in science from the University of the Ozarks.

After graduation from CSM, Lloyd was employed by Pan American Petroleum Corporation (later known as AMOCO), where he remained for 43 years. After several advancements, he was appointed chief engineer for the Pan American Petroleum Corporation in 1948 and director of production research at the corporate Tulsa research center in 1949. Under his leadership, hydraulic fracturing was invented and developed as a significant and important oil and gas well stimulation procedure and has become the cornerstone of production from unconventional oil and gas resources in the United States.

Mr. Elkins was elected president of the Society of Petroleum Engineers (SPE) in 1948 and was awarded the SPE Distinguished Service Award in 1959. He was also president of the American Institute of Mining, Metallurgy and Petroleum Engineers (AIME) in 1962 and was awarded the AIME Lucas Gold Medal and made a Distinguished Life Member in 1966. In 1951–1952, Lloyd was chairman of the American Petroleum Institute (API) Advisory Board on Fundamental Research on Occurrence and Recovery of Petroleum. A prolific writer of technical papers, he was recognized as an outstanding authority on the secondary and tertiary recovery of oil. He was a member of the editorial board and a contributing author of *The History of Petroleum Engineering* (American Petroleum Institute, 1961).

In 1961, he was awarded the Distinguished Service Medal from CSM. He was also named to the Engineering Hall of Fame at Oklahoma State University and the Engineering Hall of Fame of the University of Tulsa. He was a member of the Tulsa Geological Society and an honorary member of the Australasian Institute of Mining Engineers. His numerous other awards include the Golden Plate Award from the American Academy of Achievement, the API Citation for Service, and the University of Tulsa Citizen Award.

When Lloyd retired from AMOCO in 1977 to begin a private consulting business in Tulsa, Oklahoma, he was considered an industry leader and was known to have a passion for helping others to achieve high levels of excellence. He was subsequently chosen as a member of the prestigious Arbitration Board that divided the rights to the massive oil properties in Prudhoe Bay, Alaska.

The following statements by some of his contemporaries tell part of his story.

Dennis Gregg, a past president of SPE, wrote the following: "I had no business contacts with Lloyd, though my wife and I did have the pleasure of meeting and visiting with the Mr. and Mrs. Elkins at SPE functions. I do have one little story about Lloyd and his brother Lincoln. I went to the same high school as the Elkins brothers—Wheatridge High School in a Denver suburb. We had the same math teacher, Mrs. Pennington, who was still talking about the Elkins boys and holding them up as examples to her students a decade or more after they had graduated. They had gone on to Colorado School of Mines, and Mrs. Pennington was instrumental in pointing me—and several of my classmates—that way."

Arlie Skov, another SPE president, worked with Lloyd's younger brother, Lincoln, for many years. Skov provided the following anecdote:

> Lloyd Elkins once gave me some of the best advice I've ever gotten. In the fall of 1955, I was 27 years old, a Korean War vet, married with one child, and set to graduate from Oklahoma University in February 1956 with a B.S. in petroleum engineering (with a high GPA). Demand for petroleum engineers was high, and I had lots of job offers, mostly in operations.
>
> But I also arranged to interview with Amoco Research (then Stanolind Oil and Gas Co) in Tulsa, Oklahoma. Given the high level of demand at the time, I was properly wined and dined by many mid-level research managers who all told me my prospects in research were very bright. My last interview was with Lloyd Elkins, then head of research. We chatted for a while, and then Lloyd told me, "Your career will move faster and further in operations than in research!" Given the prior level of seemingly high interest in hiring me, I was crushed, but Lloyd was correct. Without a Ph.D. (and at my age and family status, no interest in getting one), I would have been at a disadvantage, and, too, my personality was better suited for operations. Lloyd recognized that. So I took a job in operations and lived happily ever after!

Lloyd was also an active member of his community. He was president and a board member of the Tulsa Family and Children's Service and one of the first Tulsa Library Hall of Fame honorees. He was a founder of the Tulsa Petroleum Club and a member of the Tulsa Country Club and Kiwanis Club. He was also very active in his church.

Lloyd's family included his beloved wife, Virginia, to whom he was married for 70 years, daughter, Barbara, and husband Kenneth Teel of Amarillo, a son, Lloyd Jr., and wife Judi of Alamo, California, and a daughter, Marylou Snuggs, who predeceased him. He had six grandchildren and 13 great grandchildren.

Around the home and family he was an icon and role model, just as he was in his company, industry, and community. According to his children he was a humble, loving, selfless, giving, caring husband, father, grandfather, and great grandfather.

Frederick J. Ellert

FREDERICK J. ELLERT

1929–2005

Elected in 1987

"For outstanding leadership in developing and applying high voltage direct current technology to large-scale electric utility power networks."

BY GLENN BREUER, DALE SWANN AND CLARA K. ELLERT
SUBMITTED BY THE NAE HOME SECRETARY

FREDERICK J. ELLERT was a talented engineer and business leader who was known for maintaining a balance between innovation, detailed analysis, and schedule. His impact on General Electric (GE) businesses will long be remembered.

Fred was born in New Britain, Connecticut, on April 8, 1929, to parents who had emigrated from Bavaria, Germany. Engineering was in his blood, and he set his goal early in life to become an engineer himself. Upon graduation from New Britain High School, he was awarded a four-year alumni scholarship to Rensselaer Polytechnic Institute (RPI), where he earned a bachelor's degree in1951, graduating first in his class, a master's in 1952 (with a Tau Beta Pi Fellowship), and a doctorate in 1964, all in electrical engineering.

Fred's career at GE began when he participated in a co-op program while a student at RPI. In 1952, he joined the company as a permanent employee in the Specialty Control Department, where he was engaged in the development of electronic controls for machine tools. In 1954, he transferred to the GE General Engineering Laboratory, where he played a leading role in the development of magnetic amplifiers, silicon-controlled rectifier circuits, and advanced control systems for industrial and military applications.

During this time, Fred became acquainted with Dr. Charles Merriam, author of *Optimization Theory and the Design of Feedback Control Systems* (McGraw-Hill, 1964), who stimulated Fred's interest in the field of optimization. His research in that field led to his dissertation, "Indices for Control System Design Using Optimization Theory."

Until the 1960s, high-voltage, direct-current (HVDC) transmission systems used mercury arc valves, but rapid advances in thyristor ratings showed that solid-state valves would have significant technical and economic advantages. Based on this research, GE decided to enter the HVDC business designing and manufacturing systems that incorporated static valves. After a search for a talented engineer to lead this new venture, Fred was asked to lead the GE Power Delivery Group in Philadelphia, Pennsylvania, which was working on the development of the first solid-state HV valves for use in HVDC transmission systems. Solid-state valves had considerably better availability than mercury arc-rectifier valves and soon became the industry standard. Fred also led the development of the complex controls required for these valves.

Fred held several managerial positions related to the DC transmission-equipment business, including manager of the Circuit Protection and Control Laboratory. During his 13-year tenure, Fred was a prominent figure in the development and testing of power-transmission and distribution equipment. He also authored numerous technical publications and was granted ownership of several patents.

In 1977, Fred transferred to the GE Electric Utility Systems Engineering Department in Schenectady, New York, where he led all engineering activities related to transmission and distribution, including systems development, product-application engineering, and consulting services for the utility industry worldwide. Fred and his team are credited with many innovations in system design and applications related to HVDC systems, static Var control, and series capacitors.

In 1980, Fred was promoted to general manager of the Electrical Utility Systems Engineering Department, and his responsibilities were expanded to include power-generation systems and industrial and marine applications. Fred was widely recognized for his leadership of this multifaceted business. After his retirement from this position in May 1989, Fred formed the Ellert Consulting Group, Incorporated, a consulting firm specializing in power-system economics and technology.

Fred was a member of three engineering honor societies, Tau Beta Pi, Eta Kappa Nu, and LCR, and he was elected a Fellow of both Tau Beta Pi and the Institute of Electrical and Electronic Engineers (IEEE). In 1987, he was elected a member of the National Academy of Engineering for "his outstanding leadership in developing and applying high-voltage direct-current transmission technology to large-scale electric-utility power networks."

During his career, he served on committees for IEEE, American National Standards Institute, International Electrotechnical Commission (IEC), and International Council on Large Electric Systems (CIGRE). He was chair of the IEC Subcommittee on Converters for High Voltage D.C. Power Transmission, which developed international standards for DC power equipment. He was also a member of the U.S.-U.S.S.R. Working Group on Ultra High Voltage Power Transmission, which was a forum for the exchange of technical information under the auspices of the U.S. State Department.

Fred was an Eagle Scout and a leader of the scouting organization for many years. A member of the RPI tennis team, he continued to demonstrate his athletic prowess later in life by consistently beating younger challengers in the GE tennis league.

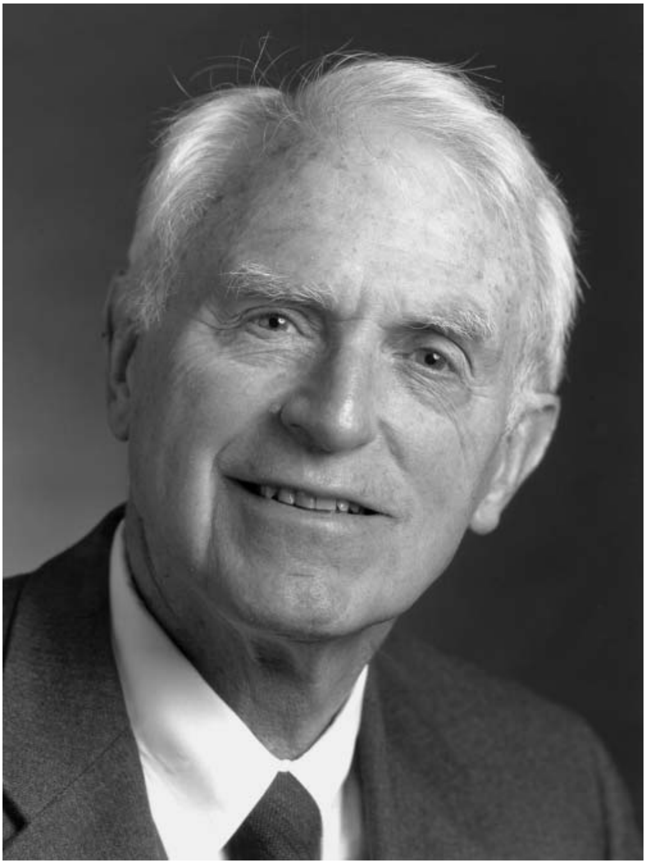
Fred died on July 13, 2005, after a courageous battle with mylodysplasia syndrome.

He is survived by his wife of 51 years, Clara; a son, Frederick Paul; a daughter, Judith Ann; and five grandchildren.

BY CLARA K. ELLERT
SUBMITTED BY THE NAE HOME SECRETARY

Fred and I were married on May 15, 1954. We met at GE where I was a secretary. We had a wonderful and happy 51 years together — we had so much in common coming from foreign parents. We had 2 fantastic children — Frederick Paul, born in 1956, who graduated with a masters degree in mechanical engineering from Cornell, and Judith Ann, born in 1960, who graduated from the University of Rochester with a degree in general science and biology and is now a practicing physician's assistant. Frederick Paul married Hilary Wichert in 1981. Judith Ann married Anthony Luscher in 1985. There are five grandchildren — Joseph A. Ellert, a welding engineer in Ann Arbor, Michigan; Ashley Rose Ellert, now Sister Pio Maria with the Dominicans in Ann Arbor, Michigan; Elizabeth M. Luscher, a junior at Ohio State; Matthew A. Luscher, a freshman at Ohio State; and Rebecca A. Luscher, who is in middle school.

Fred was a wonderful husband, father, grandfather, and friend. We spent our winter months in Florida and thoroughly enjoyed the life playing golf, walking the beach, and having fun with our many friends there. He is terribly missed and I think of him all the time.



BEN C. GERWICK, JR.

1919–2006

Elected in 1973

"For contributions and leadership in the application of engineering technology to underground, harbor, and ocean construction."

BY ROBERT B. BITTNER
SUBMITTED BY THE NAE HOME SECRETARY

WITH THE DEATH OF BEN GERWICK, JR., the nation lost one of its foremost construction engineers. He died in his home in Oakland, California, on December 25, 2006, at the age of 87. He was known worldwide for his pioneering work in prestressed concrete and his creative innovations in marine construction and deep foundations.

Ben was born in 1919 in Berkeley, California, the son of a renowned construction engineer and contractor. He developed an interest in engineering over the dinner table, listening to his father tell of his adventures on marine construction projects in the San Francisco Bay area. Ben received his B.S.C.E. *summa cum laude* with the class of 1940 from the University of California, Berkeley. Upon graduation, his Naval Reserve Training Corps unit was called into service, more than a year before the Japanese attack on Pearl Harbor. Ben took part in landings in North Africa and Sicily. Later, as a line officer, he was commander (the youngest in the U.S. Navy) of the attack cargo ship *Scania.* When the war ended, he returned to San Francisco and joined Ben C. Gerwick, Inc., the heavy marine construction firm founded by his father in 1926.

In the early 1950s, Ben became interested in the potential of prestressed concrete and converted the company's precast concrete manufacturing plant to the new technology of pretensioning. He pioneered the development of long prestressed concrete piles, which were installed by his firm for deep foundations, bridge piers, and other marine structures. Later the firm developed the deflected-strand process for pretensioned bridge girders, the precast match-casting process for bridge girders, and pretensioned railroad ties. Ben's innovations yielded him six patents and made possible the successful manufacturing, transport, and installation of prestessed piles up to 150 feet in length.

In 1952, Ben became president of the firm, which participated in the establishment of prestressed concrete fabrication plants in Kuwait and Singapore. Domestically, the company's projects included the overwater extension of La Guardia Airport in New York. The firm also became heavily involved in the design and construction of deep foundations with prestressed piles and later the design of shoring systems for deep excavations and the development and patenting of a special slurry-wall construction system incorporating soldier beams, known by the acronym "SPTC walls." This system was used to build the deep foundations for the underground BART stations in downtown San Francisco and for many high-rise buildings.

Ben was president of the Prestressed Concrete Institute in 1957 and the International Federation of Prestressing from 1974 to 1978. His firm merged with J. H. Pomeroy and then, in 1967, became part of Santa Fe International. In 1971, he joined the faculty of the University of California, Berkeley, as a professor of civil engineering. Concurrently, he set up a specialized consulting engineering practice named Ben C. Gerwick, Inc., the name of his former construction company. In 1988, this firm became affiliated with COWI A/S, Consulting Engineers and Planners, Lyngby, Denmark.

As a contractor, Ben participated in the construction of precast concrete bridge piers for several major bridges, such as the Richmond-San Rafael Bridge, and the construction of the concrete North Sea platform, the Ninian Central. As a consultant, he participated in the development of several major offshore concrete oil platforms in the North Sea. This work led the use of prestressed concrete in offshore structures that could resist sea ice and icebergs in the Arctic and Subarctic. He subsequently worked on the floating concrete structure Ardjuna Sakti for the storage of cryogenic gas and the first long-span cantilever segmental bridge in the United States.

Ben was a consultant on major prestressed concrete bridges in Europe, the Middle East, and Asia, as well as in the United States. He also advanced the concept of large-diameter steel tubular piles for major overwater bridges and was construction consultant on the design and construction of deep cofferdams for bridge piers. He provided construction engineering for the marine foundations of more than 26 major bridges worldwide.

Among Ben's honors and awards were membership in the National Academy of Engineering and the National Academy of Construction. He was an Honorary Member of the Concrete Societies of Great Britain, Germany, Sweden, Norway, and France, as well as the American Society of Civil Engineers, American Concrete Institute, and Prestressed Concrete Institute. He was the recipient of the Freyssinet Medal from the International Federation of Prestressing (FIP) and the Medal of Honor from the Prestressed Concrete Institute, as well as the Golden Beaver Award for Engineering from the heavy construction industry, the Distinguished Service Award from the Deep Foundation Institute, and the Outstanding Projects and Lifetime (OPAL) Award from American Society of Civil Engineers. He was a member of Phi Beta Kappa and Kappa Sigma Fraternity.

Ben also made major contributions to the construction industry through his work at UC Berkeley, where he initiated and led the highly successful graduate program in Construction Engineering and Management from 1971 to 1989. As professor of civil engineering for 30 years at the UC Berkeley, and in his many lectures to students and professional groups, he stressed the importance of a creative and innovative attitude in addressing engineering and construction challenges.

Ben was a highly skilled communicator, and his writings include more than 200 technical papers, book chapters, and three technical books that are widely used in the construction industry, *Construction of Prestressed Concrete* (John Wiley and Sons, Inc., 1997), *Construction Marketing for Major Project Services* (John Wiley and Sons, Inc., 1983), and *Construction of Marine and Offshore Structures,* currently in its 3rd edition (Taylor & Francis, Inc., 2007). In 2005, he completed his fourth book, *The Bridge Beyond* (Vantage Press, Inc.), a novelistic autobiography of a career in engineering.

In 1999, the editors of *Engineering News Record* (ENR) identified Ben as one of the "125 TOP PEOPLE" whose efforts in the construction industry singularly and collectively helped shape this nation and the world. That same year, Ben reflected on what he considered the most rewarding aspect of his 54-year career. Rather than the awards and recognition he had received, or even the major projects in which he had been involved, the most valuable to him were his many close friendships with dedicated people who were enthusiastic about getting things done, people who faced challenges creatively and had the courage to use their training and technical skills to accomplish great things. These people, both contractors and engineers, could be found during the design and construction of major bridges around the world, working in the North Sea installing massive floating concrete structures, in the Netherlands constructing innovative surge barriers to protect their country, and along the inland waterways of the United States building locks, dams, and marine terminals. As an added reward, many of these engineers and contractors had been his students.

"He was an engineer's engineer," said his son Bill Gerwick. "Right until the day of his death, he was sharp in his mind and incredibly thoughtful and wise. He had an exceptional kind of wisdom that was sought after by many people." Ben was a brilliant engineer, but he was able to lead and inspire people because of his human qualities and his sincere interest in them. Ben was the ethical and professional compass for many engineers in design and construction. We are fortunate to have known and worked with him, and we will miss him dearly.

Ben is survived by his wife, Ellen Chaney Gerwick; his children, Bill Gerwick, Beverly Brian of St. Joseph, Missouri, Virginia Wallace of Bainbridge Island, Washington, and Clifford Gerwick of Indianapolis; seven grandchildren; and four stepchildren. His first wife, Martelle Beverly Gerwick, died in 1995. Ben and Martelle were married for 54 years.

GENE H. GOLUB

1932–2007

Elected in 1990

"For contributions in developing and analyzing robust and stable numerical algorithms used in solving complex engineering problems."

BY CLEVE MOLER

GENE H. GOLUB, Fletcher Jones Professor of Computer Science (and, by courtesy, of Electrical Engineering), Stanford University, died on November 16, 2007, at Stanford Hospital. He was 75 years old.

Golub was born in Chicago on Leap Year's Day, February 29, 1932, to parents who had emigrated from Latvia and Ukraine. He attended public schools in Chicago and then, from 1953 through 1959, the University of Illinois, where he received a B.S. in 1953, M.A. in 1954, and Ph.D. in 1959, all in mathematics.

After a postdoctoral year at Cambridge and brief stints at Lawrence Radiation Laboratory and Space Technology Laboratories, he joined the faculty at Stanford University in 1962. In 1965, he was a founding member of Stanford's Department of Computer Science, one of the first computer science departments in the world. He became a full professor in 1970 and was chairman of the department from 1981 through 1984.

Dr. Golub was elected to the National Academy of Engineering in 1990 and to the National Academy of Sciences in 1993, and he received honorary doctorates from about a dozen universities worldwide. When he became ill, he had to cancel a planned trip to receive an honorary doctorate from the Eidgenössische Technische Hochschule in Zurich.

Gene's research and teaching interests were in the field of numerical analysis, a subject that hardly existed when he entered the University of Illinois. But as the power and availability of computers increased, so did interest in numerical analysis. Today, the subject is at the interface between mathematics and computer science. In fact, numerical analysts started many of the world's computer science departments, including the one at Stanford. Years later one of Gene's colleagues at Stanford remarked, "numerical analysis was the mother of computer science, but today she is acting like an anxious grandmother."

Many universities now have interdisciplinary programs in "computational science." In 1988, Gene was the founding director of one of the first such programs in the world. At Stanford, the program was called "scientific computing and computation mathematics."

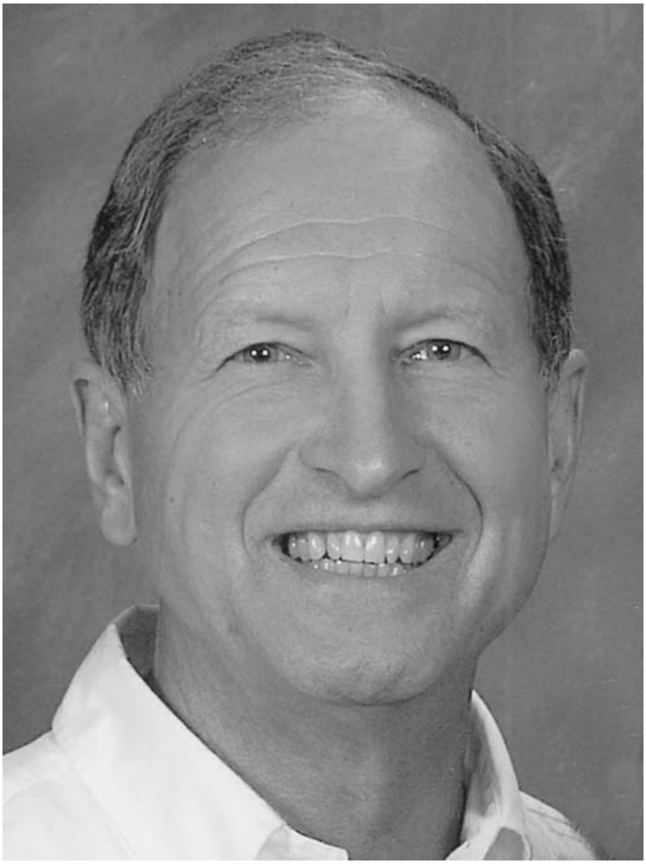
Gene's specialty was computation involving matrices. His Ph.D. thesis and some of his first research papers were about iterative methods for solving the types of simultaneous linear equations that arise in finite-difference methods for partial differential equations. In the 1950s some experts familiar with the relaxation methods that were then being done by hand were skeptical that those methods could ever be automated. But work by Golub, as well as by David Young and Richard Varga, provided the first analysis of effective iterative algorithms for these large linear systems.

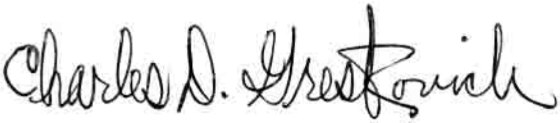
In the 1960s, together with colleagues W. Kahan and Christian Reinsch, Golub developed the first practical algorithm for computing the matrix singular-value decomposition (SVD), sometimes called the "Swiss Army knife" of matrix computation because it is used in such a wide variety of applications. A search of the U.S. Patent and Trademark Office Web page lists more than a thousand U.S. patents that mention "singular value decomposition," all of which were was made possible by Golub's algorithm. His California license plate proclaimed that he was "Prof. SVD." Golub also contributed to our understanding of a large class of iterative algorithms for matrix computations, including the conjugate-gradient method, the Lanczos algorithm, and Krylov subspace algorithms.

Golub was president of the Society of Industrial and Applied Mathematics (SIAM) from1985 to 1987 and the founding editor of two SIAM journals. He also served on the editorial boards of more than a dozen other journals. In addition, Golub founded the NA Digest, a weekly electronic newsletter that now has more than 10,000 subscribers around the world. At Stanford, he was thesis advisor for more than 30 Ph.D. students, and through them, he now has more than 140 academic descendants.

Everything I have said thus far, however, pales in comparison to Golub's most important characteristic—his humanity. The numerical-analysis and scientific-computing community was his family. The closeness and congeniality of this community is due, in large part, to his influence. Thousands of people in dozens of countries knew him simply as "Gene," and visitors to Stanford, particularly young people, often stayed in his home.

He remembered everybody's name and their children's birthdays, and he returned visits, traveling frequently to give lectures, attend workshops, or just to see people. His friendships, visits, and e-mails not only led to important algorithms and research papers, but also made the world a more pleasant place.





CHARLES DAVID GRESKOVICH

1942–2007

Elected in 2000

"For innovations in technical ceramics and their manufacturing processes."

BY DAVID W. JOHNSON AND MARIA GRESKOVICH

CHARLES GRESKOVICH, a well known and highly respected researcher at General Electric died of colon cancer July 7, 2007 at the age of 65.

Known as Chuck to all, he was born in Fredericktown, Pennsylvania on June 13, 1942, where his father was a coal miner. In 1960 he graduated from the Bethlehem Center Senior High School in Fredericktown, Pennsylvania.

Chuck studied Ceramic Science at Penn State University graduating with a B.S. in 1964 and a Ph.D. in 1968. That year he was also awarded an NSF Postdoctoral Fellowship in Germany where he studied at the Max Plank Institute. In 1969 he joined the Ceramics Laboratory of GE's Corporate Research & Development Center in Schenectady, New York as a staff ceramist. After a long productive career at The General Electric Global Research Center, he started his own consulting company in 2002, CDG Ceramic Solutions. He authored more than 60 publications and has 64 patents.

Chuck Greskovich was a researcher with scientific depth and a keen eye for engineering applications. These attributes contributed to a highly productive research career where his research and technological interests included preparation of optically transparent, polycrystalline ceramics, useful as scintillators in advanced medical x-ray detectors, arc tube envelopes for high intensity discharge lamps, ceramic lasers, and optical windows. Sintering polycrystalline ceramics to dense transparent bodies demands exacting science and process in order to remove trace porosity that scatters light. He is co-inventor of the first efficient ceramic scintillator (described in more detail below), now used in nearly all computed tomography (CT) body scanners sold by GE since 1988. He developed the "Gas Pressure Sintering Process" used by many material companies and improved refractory ceramic molds. He published more than 60 scientific papers, and was awarded 64 patents.

At the GE Research Center Chuck Greskovich mentored many colleagues and enjoyed sharing his passion for understanding the basic physical processes behind ceramic processing. A great example is the development of the HiLight scintillator, the first transparent ceramic scintillator designed to accurately measure x-ray intensity for CT medical imaging. HiLight is very effective at converting x-rays into light and when assembled into a detector it is very dose efficient. For equivalent signal levels, the HiLight detector required less x-ray dose on the patient than competing technologies. Chuck championed this project from the beginning after recognizing that his transparent yttria could be made into a dense and efficient scintillator by understanding how to add gadolinium and europium. In addition, Chuck investigated many compositional and processing routes to eliminate radiation damage and afterglow, two critical material properties for the demanding CT application. As this technology matured through the development stage it required a host of expertise, from physicists who optimized the electronic defect structure, to chemical engineers who developed the powder processing, to electrical engineers who implemented the scintillator in a digital detector. Chuck had an innate ability to communicate the technically relevant aspects of the ceramic processing to all of these people, and worked tirelessly to optimize the material properties. Everyone who worked with him on this project, both at the GE Research Center as well as the GE healthcare business, recognized Chuck's enthusiasm for the technology, and was buoyed by it. Well into his retirement Chuck would return to the Research Center to teach ceramic seminars to younger colleagues.

Chuck had an amazing talent for developing cutting-edge technology and successfully tuning a process to work in a manufacturing setting. Chuck demonstrated this skill with GE's high intensity discharge lamp business. Ceramic metal halide lamps are very efficient, greater than 6 times more efficient than incandescent lamps, and can operate for 2 years of continuous service. There are significant thermomechanical stresses on the translucent aluminum oxide envelope that contains gases at pressures up to 30 atmospheres and an arc temperature up to 6500°C. One of the challenges in the original design was that the geometrically complicated lamp envelope was comprised of five discrete parts and prone to failure at the joints. Chuck realized this problem could be overcome with injection molding of aluminum oxide to achieve a more mechanically robust three-part design. Chuck took on the challenge to develop and scaleup an injection molding process. The result was a ten times increase in joint strength, improved dimensional control with less than 100 micron variation, and increased optical transmission. In addition, injection molding offered geometric flexibility to enable product offerings not possible with conventional dry-pressing.

Chuck Greskovich was elected to the National Academy of Engineering in 2000 with the citation: "For innovations in technical ceramics and their manufacturing processes." He was widely recognized by other awards. In 1978 he received the Ross Coffin Purdy Award from the American Ceramic Society for the most valuable contribution to the ceramic technical literature published in the previous year. In 1980 he was named a Fellow of the American Ceramic Society. In 1983 he was the American recipient of the Richard M. Fulrath Award of the American Ceramic Society which took him to Japan to lecture around the country. In 1991 he was awarded a Coolidge Fellowship, the GE R&D Center's highest honor. In 1997 the College of Earth & Mineral Science at Penn State University recognized him as "Centennial Fellow" for distinguished accomplishments that bring honor to the college and university, and in 1998 honored him with the Charles L. Hosler Alumni Scholar Medal for outstanding contributions to science through research. In 2001 he was awarded the TMS Distinguished Career Award by the Hudson Mohawk Chapter of TMS.

Chuck Greskovich always was an optimist and enjoyed life to the fullest. He was socially outgoing and treated everyone as his equal. He is remembered for his warm constant smile. He was an accomplished athlete with a lifelong enjoyment of golf, tennis and basketball. He enjoyed fishing and sought opportunities to share that passion with friends.

Chuck is survived by his wife, Maria; they were married on September 16, 1966. His survivors also include his three children, Charles Jr. (Chad), Ann Zenner and her husband John, and Melissa and two grandchildren; and their two children Helen and Kilian Charles. He is also survived by his older brother Eugene.

David Johnson thanks Chuck's wife Maria and his colleagues at GE, Steve Duclos, James Vartuli, and Curtis Johnson for their help in writing this tribute.

BY MARIA GRESKOVICH
SUBMITTED BY THE NAE HOME SECRETARY

Chuck was the love of my life. He was a loving father, playing with his three children when they were young and later tutoring them all in math and science. He was always patient and understanding with them and me.

He was the life of any party, including his wife's yearly family reunion at the beach. He taught everyone how to play Bocci and Cinch, games he learned from his Italian grandparents. Then he showed everyone how to ride the waves, catch fish and crabs.

He was a man of many talents — an excellent fly fisherman, basketball player, and golfer. He enjoyed all these sports until the month before he died. He loved to eat, laugh, and tell stories.

Because he attended Pennsylvania State University on a scholarship, it seemed fitting to start an endowed scholarship in his name in Ceramic Science. He loved to share his passions and teach others and this continues that philosophy.

We miss his positive attitude, his passion for life, and his loving presence.

A quote from our youngest daughter from a poem she wrote for him on his last birthday:

> Without you I wouldn't know the meaning
> Of what a truly "Good Man" is
> Of what a classic "role-model" is
> And that heroes really do exist.

ABRAHAM HERTZBERG

1922–2003

Elected in 1976

"For contributions to heat engine, shock tube, and laser technology."

BY ROBERT G. LOEWY

ABRAHAM HERTZBERG, a highly creative and gifted aerospace engineer, died on March 27, 2003, at the age of 80. An industry and government practitioner, academician, researcher, and consultant, he had devoted 60 years to his chosen field of aeronautics and astronautics.

Abe's interest in aerodynamics was evident at an early age. As a teenager, he spent many hours building and flying model airplanes and trying to replicate Robert Goddard's experiments with rockets. He earned his pilot's license at 16 and often entertained his friends and family with stories of his adventures as a pilot.

Abe earned a B.S. from Virginia Polytechnic Institute in 1943 and went to work thereafter as an aerodynamicist for the Curtis-Wright Corporation. In 1944, with World War II still raging, he became a flight-test engineer for the U.S. Army. After the war, he left the Army and returned to school, this time as a graduate student of Arthur Kantrowitz at Cornell University. While at Cornell, Abe had a bout with polio, which left him with a weakness in one leg that required him to wear a brace. Although this condition slowed him down a bit, it never stopped him. He earned an M.S. from Cornell in 1949, and immediately went to work at the Cornell Aeronautical Laboratory (CAL) in Buffalo, New York, later known as CALSPAN.

At his farewell party at Cornell, he met his future wife Ruth (Cohen) who had just arrived to work as a mathematician in the Aeronautical Engineering Department. They courted long distance and married in September 1950. She then joined him at CAL where they worked together on the development of the shock tube, laying the groundwork for advanced hypersonic technology that is still used today.

From 1949 through 1965, Abe took on positions of increasing responsibility at CAL. He began as an engineer, was appointed assistant head of the Aerodynamics Research Department in 1957, and became head of that group in 1959. During that time, he published some 35 papers dealing, for the most part, with the use of shock tubes and their instrumentation for the study of hypersonic flows, wave engines, and high-temperature gas dynamics and related chemical reactions. By this time, Abe was well known internationally for his research in high-energy gas dynamics and spacecraft reentry physics, for the development of shock tubes and shock tunnels, and for his active, influential participation in the National Aeronautics and Space Administration's (NASA) Research Advisory Committee on Fluid Mechanics (1959–1967).

When academia called in 1966, Abe responded, accepting the position of professor of aeronautics and astronautics and director, Aerospace Research Laboratory (ARL), at the University of Washington (ARL was later renamed by him to Aerospace and Energetics Research Program [AERP]). Initially Abe continued the work he had initiated in his later years at CALSPAN in Buffalo, but as time went on, his research broadened to include gasdynamic lasers, controlled thermonuclear fusion, engine-cycle improvements, thermal management of spacecraft (the liquid droplet radiator), a new hypervelocity launcher concept (the ram accelerator), cryogenic automobile propulsion, and the shock-wave chemical reactor for petrochemical pyrolysis, among other topics. He quickly developed into the most prolific researcher in his department and built a legendary following among his students. His work resulted in another 80 journal papers, reports, and papers in proceedings of national and international conferences. In the process, Abe also guided 14 students to their master's degrees and seven to their doctorates. In addition he played a key role in hiring and mentoring new faculty; three of the faculty he attracted to the Aeronautics & Astronautics department went on to become chairs of the department.

Abe's enthusiasm for teaching extended beyond the professional setting. He loved to explain the workings of machines and natural phenomena to everyone around him. When his children were very young, a favorite family activity was to have a picnic dinner behind the Buffalo airport and watch the planes. Abe passed on his love of flight to his children through those early lessons in aerodynamics, inspiring two of them to get pilots licenses. His lessons on airplanes and auto mechanics inspired his son Paul and daughter Biz to become engineers. Biz has followed in her father's footsteps with her research in fluid dynamics as a professor of engineering at the University of Colorado.

Abe Hertzberg's intellect, creativity, insatiable curiosity, and aptitude for matters technological, as well as his straightforward, often forceful way of expressing himself made him a highly sought-after committee man, consultant, and advisor to federal agencies, industry, and professional societies. Abe always gave unselfishly of his time and energy in providing the desired services. As a full-time faculty member at the University of Washington, he somehow found time—over the years—to serve as a member of 13 NASA committees (and chair of two), six of them associated with the NASA Research and Technology Advisory Council (RTAC) and seven associated with the NASA Space Systems and Technology Advisory Committee (SSTAC); a member of the Air Force Scientific Advisory Board (1966–1978), including membership on seven panels/committees (and chair of two); a member of the U.S. Air Force Aeronautical Systems Division Advisory Group (1970–1973), including membership on eight panels/committees (and chair of one); and membership on technical and award selection committees of the American Institute of Aeronautics and Astronautics (AIAA) and other national service activities, such as membership on the advisory committees of the Defense Intelligence Agency, National Science Foundation, Los Alamos National Laboratory, and the National Academy of Sciences Government-University-Industry Research Roundtable Working Group.

With his always affable, intense personality, Abe was fun to be around. He had a grasp of fundamentals and inventive insights into their practical applications that are so valuable in an engineer. He held no fewer than 21 patents, dating from 1958 through 1994.

His honors and awards, in addition to membership in the National Academy of Engineering, include Fellow of the AIAA and recipient of that organization's Plasmadynamics and Lasers Award and Dryden Lecture Medal; Fellow of the International Astronautical Federation; Honored Speaker / Keynote Lecturer for the Chinese Academy of Sciences (1983) and Citizens of Sendai, Japan (1991); Minta Martin Lecturer, University of Maryland (1975); the Laser Institute of America (1975); and he was twice named Paul Vielle Lecturer, the opening invited talk at the biennial International Shock Wave Symposium.

Ruth joined him on his international travels and their home was filled with evidence of those travels. They enjoyed entertaining guests to the Seattle area, many of them friends they met on their overseas travels. Abe and Ruth particularly enjoyed taking their guests deep-sea salmon fishing, even though they frequently said they were philosophically opposed to any activities that took place before noon.

The long-term importance of Abe Hertzberg's contributions can be inferred from a passage published in 2004, in "A History of the University of Washington Department of Aeronautics and Astronautics 1917–2003," by J. Lee, D. S. Eberhard, R. E. Breidenthal, and A. P. Bruckner.[1] In describing the Aerospace Research Laboratory (ARL), "devoted to advanced, multidisciplinary aerospace engineering research," they wrote

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[1] Lee., J. S., Eberhardt, D. S., Breidenthal, R. E., and Bruckner, A. P., "A History of the University of Washington Department of Aeronautics and Astronautics 1917–2003," in *Aerospace Engineering Education in the First Century of Flight*, McCormick, B., Newberry, C., and Jumper, E., eds., AIAA, 2004, pp. 151-167.

that Hertzberg "and collaborators John M. Dawson of Princeton University and R. E. Kidder of Lawrence Livermore, and their colleagues, presented a paper titled, 'Controlled Fusion Using Long-Wavelength Laser Heating with Magnetic Confinement,' at the Esfahan Symposium on Fundamental and Applied Laser Physics in Esfahan, Iran, in late summer 1971. This seminal paper established the firm foundation of the fusion program at ARL, which continues to this day." Virtually everything Abe Hertzberg did in his professional life had that kind of visionary interest.

Mr. Hertzberg was preceded in death by his wife. In her memory, he established a fund at the University of Washington to support and encourage engineering graduate students, especially women. He is survived by daughters Ellie Hertzberg, of Acton, Massachusetts, and Jean (Biz) Hertzberg of Boulder, Colorado; son Paul Hertzberg of Baltimore, Maryland; sister Bella Jacobs of Chevy Chase, Maryland; and two grandchildren, Allison and Samuel.

Abe is deeply missed by those who knew him and remember him for his enthusiasm for life and his work, his humor, and his ability to dominate a room with the power of his ideas and intellect.

C. LESTER HOGAN

1920–2008

Elected in 1977

"For contributions in microwave ferrite devices and leadership in the semiconductor industry."

BY DAVID HODGES AND ERNEST KUH

CLARENCE LESTER (LES) HOGAN, scientist, engineering scholar, inventor, university professor, industrialist, pioneer, and leader in the semiconductor industry, passed away on August 12, 2008.

Les was born on February 8, 1920, in Great Falls, Montana. After graduating from Montana State University in 1942 with a degree in chemical engineering, he joined the U.S. Navy and worked with scientists at Bell Labs on the development of acoustic torpedoes. He was then sent to the Pacific Theater to train submarine crews in the use of that technology. After the war, he enrolled at Lehigh University, where he earned a Ph.D. in physics.

In 1950, he joined the staff of Bell Labs, and shortly thereafter he invented the microwave gyrator. For his inventions, he was granted U.S. Patents 2,748,353 and 2,887,664, among others. The microwave gyrator, which is essential for controlling the direction of signal flows in radar and microwave radio-communication systems, is widely used today in many microwave devices.

Les joined the faculty of Harvard University in 1953 and in 1957 was named the Gordon McKay Professor of Physics. After five years at Harvard, he was recruited by Motorola, which was located in Phoenix, Arizona, as general manager of its semiconductor operation. In the 1960s, under his leadership, Motorola became the most profitable chip maker in the world, and Les was recognized as having an unusual combination of technological expertise and market insight. In 1968, he became president of Fairchild in Mountain View, California, and seven semiconductor experts from Motorola came after him. The outraged company sued but to no avail as Les had not done anything unethical. Les was president of Fairchild until 1974, when he became vice chairman of the company's board of directors. He retired in 1985.

Les Hogan was elected to the National Academy of Engineering in 1977. He received the Institute Electrical and Electronics Engineers (IEEE) Frederik Philips Award in 1975, and the IEEE Microwave Pioneer Award in 1993. He received the Eta Kappa Nu award in 1997. He was vice President of IEEE for several years.

For many years after his retirement, Les was an adviser to leading universities, including the Massachusetts Institute of Technology, Montana State, Lehigh University, Stanford, University of California, Berkeley, Princeton, and Yale. At Berkeley, he was not only a commencement speaker but also helped in developing university/industry relations. He was a major force in creating Berkeley's research program in computer-aided design, for which a conference room was named in his honor. In addition, in recognition of his many contributions, a friend and former associate endowed the C. Lester Hogan Professorship in the College of Engineering at Berkeley. His wife remembers that his life focus was teaching.

Les was a warm person who had many friends from academia and industry, whom he and his wife Audrey entertained at their home in Atherton, California. These memorable parties, which were the settings for fruitful exchanges of knowledge and friendship between these two important segments of the Silicon

Valley population, undoubtedly influenced the development of high-technology industry in California.

Les is survived by his wife, the former Audrey Biery Peters. They were married for 62 years. A daughter also survives, Cheryl Lea Hogan, and two grandsons, Marc and David Aymerich.

JOHN K. HULM

1923–2004

Elected in 1980

"For contributions to the theory and to the development of superconductors, and leadership in their application."

BY JOHN W. COLTMAN

JOHN KENNETH HULM, an internationally known scientist, engineer, and activist in the field of superconductivity, had the distinction of being elected to both the National Academy of Engineering and the National Academy of Sciences for his many contributions to the understanding of the fundamental properties of materials at very low temperatures, the development of practical superconducting materials, and their application to high-field magnets. He died on January 16, 2004 at the age of 80.

John was born in the small town of Southport, England, on July 4, 1923. His father, a modestly paid railway worker with little education, was determined that his son would not lack for one. John's interest in science was stimulated by a remarkably skillful educator, the headmaster of the local high school, and after graduation he attended Cambridge University. He completed his undergraduate work there in 1943 and then joined the Royal Aircraft Establishment, where he worked on the development of radar until the end of World War II.

After the war, he returned to Cambridge University as a research fellow to pursue a graduate degree under David Schoenberg, a pioneer and central figure in the field of low-temperature physics. Toward the end of his graduate research at the Cavendish Physics Laboratory, he met his wife-to-be, Joan, whom he married in 1948. The results of his Ph.D. thesis on the thermal conductivity of superconductors and the ferroelectric properties of barium titanate were published in Nature, the first of some 100 publications during his lifetime.

In the fall of 1949, John travelled from England with his wife and month-old baby to the University of Chicago, where he had a postdoctoral position as a Union Carbide Research Fellow. Two years later, he was appointed assistant professor of physics. His highly productive research work there resulted in the discovery, with George Hardy, of the A-15 superconducting alloys, binary compounds of elements that exhibited superconductivity at temperatures as high as 17 degrees Kelvin. Together with B. T. Matthias, John published 14 technical papers based on his work in Chicago.

In 1954, John accepted an offer from the Westinghouse Electric Corporation research laboratory in Pittsburgh, where he assembled a team of researchers on the physics of materials, particularly superconductivity. In 1956, he was named manager of the Solid State Physics Department. Four years later he became associate director, Material Science, with several departments under his direction. In spite of his administrative duties, which were by no means negligible, he continued to participate actively in the research and development of superconductivity.

Superconductors ordinarily lose their zero resistance in the presence of a small magnetic field, or when they carry any but a small current. A major breakthrough occurred in 1961 with the discovery that a niobium-tin alloy maintained its zero resistance under magnetic fields as high as 10 Tesla, far above the saturation point of iron. Alloys of this type, including niobium-titanium, are called Type II superconductors. When these alloys were properly fabricated into wire, they could sustain currents on the order of 10,000 amperes, thus opening the possibility of producing magnetic fields higher than any achieved before. At this point, John Hulm became an engineer as well as a scientist and administrator.

One of his first goals was to produce a high-field solenoid. Using long lengths of wire fabricated from niobium-zirconium and niobium-tin, the group under Hulm's direction succeeded in fabricating magnets up to 10 Tesla. This compares with 2 Tesla, the best that could be done with an iron magnet. Today magnets as high as 26 Tesla have been produced, and many large superconducting magnets are crucial components of the Large Hadron Collider, which was scheduled to become operational in 2008.

When Westinghouse engineer John Mole returned to Westinghouse from a stay at Massachusetts Institute of Technology, he reported on work being done there on superconducting rotating generators. Together, he and John then initiated a program at Westinghouse to apply superconductivity to power generators. The problems of cooling rotating parts with liquid helium were substantial, but by 1972 a group under Mole and James Parker had successfully demonstrated a 2-pole, 5-megawatt superconducting generator. Westinghouse obtained a contract from the Air Force to design and develop a superconducting generator for aircraft, and with the participation of engineers from operating divisions and the leadership of Richard Blaugher, a 14,000 rpm rotor was successfully tested. Westinghouse also entered into a jointly funded program with the Electric Power Research Institute directed toward the eventual construction and testing of a prototype 300-megawatt generator. However, because of the poor business climate for power equipment at the time, the program was terminated by mutual agreement. Although John's support and interaction with these outside agencies was important, he took no direct part in the engineering itself.

In 1974, John took a two-year leave of absence from Westinghouse to become the science attaché to the U.S. Embassy in London, England. This change of scene gave him an opportunity to renew his many acquaintances and connections there. He returned to Westinghouse as manager of the Chemical Sciences Department, and in 1980, he was named director of corporate research and R&D planning. He retired in 1988 as Chief Scientist.

Because of John's prominence in his field, his communication skills, and his organizational abilities, he was often called upon as an investigator, advisor, and organizer. Among his activities were membership on several committees of the National Science Foundation and the National Academy of Sciences, program chairman of two Applied Superconductivity Conferences, of which he was a founding member, participation in a number of advisory and visiting committees for government and university organizations, and member of the boards of physics societies and journals. In 1989, he accompanied Mildred Dresselhaus, chair of the Japanese Technology Evaluation Center (JTEC) Superconductivity Panel, to Japan to evaluate their superconductivity research. Upon his return, he briefed the President's Science Advisory Council on the results of the JTEC study and their implications for the U.S. superconductivity research program. The President subsequently announced a renewed U.S. initiative in high-temperature superconductivity research and applications.

John received many honors for his contributions: the John Price Wetherill Medal of the Franklin Institute; the American Physical Society's International Prize for New Materials; the Westinghouse Order of Merit; and election to the National Academy of Sciences and NAE. Perhaps he appreciated as much or more the informal celebrations in his honor given by his co-workers, associates, and well-wishers.

John was both sociable and witty, and those who accompanied him on his many excursions always welcomed the opportunity to be with him. Family life was important to him, and after retirement he was able to spend more time with his wife Joan and their son and four daughters. He doted on his children and helped them to obtain the best education possible. He and Joan also enjoyed travelling, especially to England to visit relatives and former colleagues. Having come from a railroad family, John always loved trains, so wherever they traveled they explored local train history and often traveled by train. He especially liked to learn about old railroads, steam engines, and rolling stock.

In January 1991, John suffered a severe stroke that significantly limited his activities. He fought his way back, however, and kept up with advances in science and engineering for another six years, during which he met often with former colleagues and kept in touch with his eminent scientific friends with whom he continued to make scientific contributions. He also continued to attend scientific conferences, and traveled to England, where he attended a reception at his former alma mater at Cambridge University for the opening of the new library.

John K. Hulm played a prominent role in advancing the progress of superconductivity from a little-understood phenomenon in pure science to advanced technology and important applications. His activism, his inspiring leadership, and his technical contributions will be long remembered.

F. KENNETH IVERSON

1925–2002

Elected in 1994

"For development of the mini-mill concept in steelmaking, which revitalized the American steel industry."

BY MERTON C. FLEMINGS

F. KENNETH IVERSON, former chief executive of Nucor Corporation, revolutionized the steel industry and turned his steel mini-mill into the nation's largest steel producer. He died on April 14, 2002, in Charlotte, North Carolina, at the age of 76.

In an industry known for bankruptcies, an inability to innovate, and labor turmoil, Kenneth Iverson outdid the competition by recycling steel scrap into products using small, cheap, cost-efficient mini-mills, which were once on the fringes of an industry dominated by expensive blast-furnace technology. Ken bucked industry trends and turned his company into a survivor while others fell by the wayside.

Iverson was born in Downers Grove, Illinois, a rural town west of Chicago. He attended Northwestern University from 1943 to 1944 but left to serve in the Navy in World War II, reaching the rank of lieutenant. In 1946, he returned to complete his undergraduate studies at Cornell, where he earned a degree in aeronautical engineering. In 1947, he received a master's degree in metallurgy from Purdue.

After several engineering jobs, Ken joined the Vulcraft Unit of the Nuclear Corporation of America. Based in Florence, South Carolina, the Vulcraft Unit made steel products. In three years, Ken had made his steel division a success, while the rest of the company was headed for bankruptcy. In 1965, he was named president of the company, after which he proceeded to shed the money-losing businesses and focus exclusively on making steel using new mini-mill technology.

Nuclear Corporation opened its first mini-mill in Darlington, South Carolina, where it produced inexpensive steel for joists, steel grates, and other products. But with Ken's innovative leadership and technological innovation, he soon found that he could produce steel for the general market at a profit. From that point on, under a new name, Nucor, the company grew rapidly. By the early 1980s, it had become the most profitable steel operation in the world. In 1992, Nucor's sales reached $1.6 billion.

Ken was an innovative, risk-taking manager. His "lean-and-mean," highly decentralized management style has become a model, not only for the steel industry but also for the management of technology generally. Some of his revolutionary management principals, included empowering everyone in the company to make decisions, minimizing the layers of heirarchy, treating people as equals, and encouraging innovation.

Widely recognized for his technological and management achievements, in 1983 Ken received the Robert Earll McConnel Award of American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME). In 1991, he was given the Willie Korf Award of the American Metal Market, was named U.S. Steelmaker of the Year by *Iron Age,* and received the National Medal of Technology from President George H. W. Bush. He was elected to the National Academy of Engineering in 1994 "for development of the mini-mill concept in steelmaking, which revitalized the American steel industry."

A popular speaker on the corporate lecture circuit, Ken distilled his business philosophy into a book, *Plain Talk: Lessons from a Business Maverick* (Wiley, 997). One of his often-quoted maxims was that mistakes were as much a part of his job as successes. “My goal,” he said, “is to make the right decision 60 percent of the time.”

Ken stepped down as Nucor’s chief executive in 1996 and retired as Nucor chairman in 1998. Ken’s wife, Martha, died in March 2007. He is survived by a daughter, Claudia Sturges; and a son, Marc Miller Iverson, both of Charlotte.

DAVID N. KENNEDY

1936–2007

Elected in 1998

"For planning and management of water resources."

BY JEROME B. GILBERT

DAVID N. KENNEDY planned and managed California's water resources and the supply to more than 30 million people for the last part of the 20th Century. He died December 23, 2007, at age 71 in Sacramento. He was elected into the National Academy of Engineering in 1998 for "planning and management of water resources."

Born in Oregon in 1936, David was the son of a civil engineer who in later years retired as a professor from the UC Berkeley Institute of Transportation and Traffic Engineering. When David was once asked to state his career goal, he said, "I didn't remember thinking about becoming anything other than a civil engineer." In 1954, he entered the University of California (UC), Berkeley as an engineering major. A competitive swimmer in high school, David played on the university's water polo team. During the summers of 1956, 1957, and 1958 he worked for the California Division of Highways as a surveyor. At UC Berkeley he participated in the ROTC program. He graduated in 1959.

Having participated in the ROTC program at UC, Berkeley, David entered the army where he went through basic training at Ft. Belvoir, Virginia to become a commissioned officer. He was then assigned to Fort Ord in California as a lieutenant in the Army Corp of Engineers. He and his wife, Barbara, whom he met at UC Berkeley, lived nearby in Carmel. During this time, David became interested in water resources. When he was released from active duty in 1961, he returned to UC Berkeley to work on a master's degree with a focus on hydrology and project planning. Within nine months he received his degree and in 1962 joined the California Department of Water Resources (DWR). Initially he worked on the design of the California Aqueduct. Over the years, he moved up the leadership ranks, both at DWR and then at the Metropolitan Water district of Southern California (MWD), returning to DWR as Director and retiring after 16 years in 1998.

In the 1960s, David developed and published the first California Water Plan and worked on other major projects, such as the Dos Rios Reservoir. When DWR was downsized after the completion of much of the engineering work on the State Water Project, he joined the staff of MWD as an engineering and strategic staff analyst. In 1974, at the age of 35, he was appointed assistant general manager of MWD. He subsequently became its key policy analyst and spokesman, particularly on matters related to the Colorado River.

Toward the end of his career at MWD, David was engaged in California's epic water-policy battles, centered mostly on the construction of the Peripheral Canal, a conveyance facility to move water around the eastern edge of the Sacramento-San Joaquin Delta to pumps that would deliver water to agricultural and urban users for state and federal projects in the Bay Area, the Central Valley, and Southern California. This project continues to be the focal point of California's water disputes. David's rationale remains valid to this day. However, his advocacy was not sufficient to convince voters who defeated the project in a 1982 state referendum. For years thereafter, he cited that referendum as an example of why water agency leaders should work out their differences and present a united front instead of having the courts or the legislature resolve their differences.

In 1982, California elected a new governor, and, at the urging of William Gianelli, former DWR director, Kennedy accepted the appointment of Director of the California Department of Water Resources. In describing David, Bob Potter, David's friend and deputy at DWR, said, "He had a strong belief that a healthy future for California depended upon developing and protecting a reliable water supply." While at MWD, David greatly improved relations between MWD and DWR, and the working relationship he established continues to this day. During an interview in 2002, he predicted that "a governor will have to personally . . . provide the . . . leadership to address unresolved issues for the Sacramento-San Joaquin Delta projects." In 2008, Governor Schwarzenegger spoke out in accord with this philosophy.

Known as California's "water czar," David was Director of Water Resources of California for nearly 16 years. During those years, he rode the ebbs, flows, and tsunamis of California's complex and controversial water disputes. When Secretary of the Interior Bruce Babbitt called upon California to develop a plan to live within its 4.4 million acre foot entitlement from the Colorado River, a reduction of 700,000 acre feet, David was asked to mediate between California's water users. He developed potential water savings through agreements, recovery of canal seepage, conjunctive use, and desalination of drainage water. This plan became the basis for the 2008 water-transfer program to supply water to rapidly growing San Diego County.

David Kennedy demonstrated how western water management could be adapted to changes in public values and attitudes. He felt it was possible to make steady progress in the face of change. When he was elected a member of NAE in 1998, he was cited for "his ability to nurture consensus on challenging water issues, working cooperatively with legislatures, water users, regulatory agencies, and environmental and business groups to formulate and put into action sound water resources policies, programs, and projects."

David's peers have variously described him as a mentor, conservative, and although reserved, a knowing, and understanding boss. Rather than dictate solutions to problems, he stood back and let people seek their own solutions. He had an eye for talent and keen insight into the impacts of operational and fiscal issues. In 1997, he led the response to widespread floods in California. Afterward, he gave each DWR staffer a copy of the classic *Battling the Inland Sea* (University of California

Press, 1998), a history of floods and public policy in the Sacramento Valley. David wrote the forward to the new edition and helped arrange for its publication by the University of California Press. In 1997 UC Berkeley honored David Kennedy with its Distinguished Engineering Alumni Award.

David's intellectual pursuits went beyond technical engineering expertise. He had a lifelong fascination with history, especially the military and political history of World War II and also with astronomy, physics, and governmental politics. He traveled abroad including Europe, Russia, China, and the Middle East. He made a point of visiting Roman antiquities, including aqueducts. He had a keen sense of humor. In the 1980s, one morning after a major decision on the State Water Project, David received a call from a professional friend. The friend explained his unhappiness—at great length. When he stopped there was a long pause, and David said, "BJ, tell me what's really on your mind." He also had presence of mind. In 1990, when he led a visiting delegation to the Soviet Union, the group attended a dinner in rural Central Asia. The Russians offered a toast, but David, who was not a drinker, smiled and lifted a forkful of food instead of his glass of vodka as a gesture of goodwill to his hosts.

When asked about his transition to the slower pace of retirement, David responded, "The joke in my family is that it took me about two hours to adjust to retirement." During his retirement he accepted invitations to speak in Japan about the Sacramento-San Joaquin Delta and in China about financing for the California State Water Project on behalf of the World Bank. He was appointed by the Department of Defense to serve on a panel of experts studying the levee failures in New Orleans after Hurricane Katrina.

David's life and career were dedicated to public service and to engineering in the highest sense. He made complex, controversial aspects of California's water system understandable to many and steadfastly supported its improvement to ensure that the water needs of the people of California were met. He was the ideal leader for the largest state water program in the nation and a role model for the engineers responsible for California's water management in this 21st century.

A devoted husband and father, David never let the pressures of his work intrude on his family life. He also cherished his friends. He loved getting together with a circle of friends each Friday to have lunch and swap stories. David was an avid reader who enjoyed fixing things ("puttering" as he would say), gardening, and taking walks with his wife. David was also an active member of his church.

He is survived by his wife, Barbara, of Sacramento, California; daughters Ann Kennedy Watembach, also of Sacramento, and Susan Orttung of Arlington, Virginia; son, Richard Kennedy of Brea, California; sister, Colleen Engstrom of Walnut Creek, California; six grandchildren; and many nieces and nephews.

PHILIP E. LAMOREAUX, SR.

1920–2008

Elected in 1987

"For geological and geotechnical contributions to groundwater resource development and to hazardous waste disposal and management."

BY JAMES K. MITCHELL

PHILIP ELMER LAMOREAUX, SR. of A. E. LaMoreaux and Associates, Inc., died at his home in Tuscaloosa, Alabama, on June 23, 2008, at the age of 88. He was a leading figure in the development of hydrogeology and environmental geology, two of the most dynamic subdisciplines of geology in the late twentieth century and an internationally recognized contributor to the field of hydrology of karst terrains.

Born in Chardon, Ohio, on May 12, 1920, Philip LaMoreaux received a B.A. from Denison University in 1943, an M.S. from the University of Alabama in 1949, and an Honorary Doctor of Science from Denison University in 1972. He was a registered professional geologist in 14 states.

Philip LaMoreaux's professional career included working in several federal and state agencies, academic institutions, and as a private consultant. After serving as a geologist with the U.S. Geological Survey (USGS) in Tuscaloosa, Alabama, from 1943 to 1945, he was the district geologist in charge of the USGS Groundwater Office in Alabama from 1945 to 1957. He began teaching geology and hydrogeology at the University of Alabama as an adjunct professor in 1945 and continued in that position until his retirement from the university in 1985. During 1957 and 1958, Dr. LaMoreaux was division hydrologist in charge of water resource programs in the 14-state Mid-Continent Area of the USGS. From 1959 to 1961, he was chief of the USGS Groundwater Branch in Washington, D.C., where his responsibilities included supervising all USGS groundwater activities in the United States and its possessions.

From May 1961 to August 1976, Dr. LaMoreaux was state geologist and oil and gas supervisor for Alabama, a period during which the state surrey became one of the leading state geological agencies in the country; the agency's work covered geology, minerals, water, energy, and the environment. His consulting firm, LaMoreaux and Associates, Inc. (PELA), which was incorporated in 1975, carried out assignments in all of these areas internationally; he was president (1970–1987), chairman of the board (1987–1990), and then senior hydrogeologist of the company. Dr. LaMoreaux visited 33 countries in carrying out assignments as a representative of U.S.AID, World Bank, and FAO/United Nations, as well as a private consultant. He was especially proud of his successes in finding and developing groundwater resources in the arid Middle East.

Dr. LaMoreaux authored approximately 150 scientific and technical publications in his areas of expertise and held several editorial positions. In 1983, at the request of the president of the University of Alabama, he organized and directed the Environmental Institute for Waste Management Studies, which was established in response to environmental issues that came to the fore during the late 1960s and 1970s. This pioneering institute brought together 10 nationally recognized experts in a range of engineering and scientific disciplines to study and report on technical, social, and economic issues related to the safe management of wastes and the protection of the environment.

During his career, Philip LaMoreaux was a member of some 30 different professional and scientific societies and held significant offices in many of them. He was the first chairman of the Hydrology Division of the Geological Society of America, chairman of the Groundwater Division of the American Geophysical Union, president of the Association of American State Geologists, vice president and president of the American Geological Institute, vice president and president of the International Association of Hydrogeologists, chairman of the

Board of Trustees of the Geological Society of America Foundation, and editor-in-chief of *Environmental Geology*. He also served on numerous advisory panels to federal agencies, including Oak Ridge National Laboratory, Environmental Protection Agency, USGS, and the U.S. Department of the Interior. In each of these positions he demonstrated an extraordinary ability to visualize all aspects of a problem and focus the efforts of individuals in the group on solving it.

Among Dr. LaMoreaux's many awards were honorary memberships in 10 societies in the United States and abroad. He was elected to NAE in 1987 and served on numerous National Academies boards and committees throughout his career. These included the Board on Radioactive Waste Management, Committee on Hazardous Waste Management, National Committee for the International Hydrogeological Decade, Board on Mineral and Energy Resources, Geotechnical Board, and Board on Earth Sciences and Resources.

Colleagues and friends have described Phil LaMoreaux as "a wonderful, compassionate man" who could "charm a bird out of a tree," "a tough taskmaster who gave you a job to do and expected you to do it," and "someone who valued talent and was willing to give you a chance." Family members often accompanied him on international trips, and his youngest son, Jim LaMoreaux, recalls: "He never met a stranger. He traveled all over the world, and it didn't matter what country or what culture—he was interested in people and their culture. . . . Whether it was a colleague or a student that he taught, or an employee, he always imparted something special . . . that they really appreciated, and (they) learned to become better professionals and people because of it."

While Phil was engaged in a project to discover and develop groundwater resources deep beneath the Western Desert in Egypt, he developed a passion for the study of the biblical Exodus and the parting of the Red Sea. This led to publication of a book, written with an Egyptian colleague, on applications of hydrogeological theories to aspects of Moses' trek across the Egyptian desert.

Philip E. LaMoreaux is survived by his wife of 64 years, Bunnie LaMoreaux; two sons, Philip E. LaMoreaux, Jr. and James W. LaMoreaux; a daughter, Karen LaMoreaux Bryan (deceased as of March 9, 2009); and nine grandchildren and one great-grandchild. This extraordinary professional and gentleman has left an unparalleled legacy.

From the family

To relax dad liked to spend time with his family at a farm about 15 miles outside of town. Many special memories linger of birthdays, anniversaries and holidays celebrated at the cabin on the property. He also tended a garden and loved to share the fruits of his labors with friends and family members. Many people who were sick or in need of an emotional lift were given beautiful flowers and vegetables from his garden to brighten their day. His family was much like his garden.

He loved his wife, children, and grandchildren and was very generous in his time and contributions to their lives. He also touched the lives of their friends, many of whom said he was like a father figure to them. In fact, during the almost 65 years that he and mom were married they traveled all over the world visiting friends and meeting with colleagues and former students with whom they had stayed in close contact. They had many wonderful and unique experiences that they shared together and with this extended family. Dad published an annual series of vignettes of their personal memories and numerous travels which he gave to family and friends.

Although the immediate family knew many of these people and/or had heard stories about them, we were overwhelmed by the condolences from around the world that helped us know how many lives dad had impacted. Dad lived his life to the fullest and shared his enthusiasm for life and his work with all of us and would want us to do the same.

William S. Lee

WILLIAM S. LEE

1929–1996

Elected in 1978

"For leadership in the development of large multi–purpose electric power projects in an economical and environmentally compatible manner."

BY ROBERTA BOWMAN AND LYNNE HOLMES
SUBMITTED BY THE NAE HOME SECRETARY

AT THE UNIVERSITY OF NORTH CAROLINA at Charlotte (UNCC), an original mural commemorates the man for whom the engineering school is named—William States Lee III. Because the artist found it impossible to capture his essence in a single image, she used more than a dozen likenesses to convey the spirit and energy of his character.

Like the mural, Bill Lee's life was a composite of many skills and interests—he was a consummate engineer, a visionary leader, and a generous giver. Before his untimely death in 1996 at the age of 67, he left indelible impressions on the people whose lives he touched, on the profession he embraced, on the industry he served, and on the world he lived in.

The Engineer

Bill was born in Charlotte, North Carolina, in 1929, and you could say engineering ran in his blood. His grandfather, William States Lee Sr., had helped found, and was chief engineer of Southern Power Company. The company, later called Duke Power and eventually Duke Energy, became one of the world's largest and most respected energy companies.

Lee III graduated from Princeton University with a degree in civil engineering, Phi Beta Kappa and magna cum laude, in 1951. He served in the U.S. Navy Civil Engineering Corps during the Korean War and returned to Charlotte with his bride, Janet, in 1955.

Bill joined Duke Power in 1955 as a junior engineer—a choice inspired more by the chance to work with the company's nationally renowned chief engineer, David Nabow, than by a desire to follow in his grandfather's footsteps. Bill planned to stay with the company for a few years and then start his own engineering firm or look for a position in another, more exciting industry. But what started as a job led to a lifelong passion for Duke Power and the energy industry.

By 1965, after a series of promotions, Lee had become vice president of engineering. He was elected to the Board of Directors in 1968. He was promoted to senior vice president of engineering and construction in 1971, executive vice president in 1976, and president and chief operating officer in 1978. In 1982, he became chairman and CEO, and in 1994, when he retired, he was named Chairman Emeritus.

A registered professional engineer in North Carolina and South Carolina, Lee was elected to the National Academy of Engineering in 1978. Throughout his career, he received many other awards and honors. He was elected a Fellow of the American Society of Mechanical Engineers (ASME) in 1972 and was awarded the ASME George Washington Gold Medal also in 1972, the Outstanding Leadership Award in 1981, and the James N. Landis Medal in 1991. He was named the Nation's Outstanding Engineer by the National Society of Professional Engineers in 1980; he received the American Nuclear Society Walter Zinn Award in 1980 and the Henry DeWolf Smyth Award in 1991. He was named Outstanding Utility CEO of the Year eight times and CEO of the Decade in 1989 by *Financial World* magazine.

The Leader

Bill Lee's career paralleled an era of intense growth in the U.S. electric power industry. Duke Power was challenged to keep pace with the Carolinas' accelerating economy and the region's growing need for electric power. His grandfather, William States Lee Sr., had acted on the belief that the company could build its own generation fleet more economically and efficiently than any outside contractor. Bill Lee continued that "do-it-yourself" tradition. Throughout his tenure at the company's helm, Duke Power was known for excellence in designing, engineering, building, operating, and maintaining its own power plants.

In 1962, Bill Lee was named chief engineer for the first commercial nuclear plant in the Southeast, Parr Nuclear Station in South Carolina. Under his engineering and executive leadership, the company brought seven nuclear generating units on line in the 1970s and 1980s—three at Oconee Nuclear Station in South Carolina, two at McGuire Nuclear Station in North Carolina, and two at Catawba Nuclear Station in South Carolina.

Bill Lee believed passionately in the potential of nuclear energy to provide electricity and promote peace. By reducing the world's dependence on oil-producing nations, he believed, nuclear energy could reduce the probability of going to war over oil — while strengthening national economies and protecting the environment by reducing emissions.

After the Three Mile Island (TMI) accident in 1979, the industry called on Lee to lead the recovery efforts. Amid national concerns over the safety of nuclear power and facing political calls to shut down nuclear plants, Bill Lee offered a better solution. Instead of closing plants, he argued, the industry could learn valuable lessons from the TMI experience, an idea that led to the creation of the Institute of Nuclear Power Operations (INPO), an industry group dedicated to self-monitoring performance and improving safety. Lee served as INPO's first chairman from 1979 to 1982.

After the Chernobyl disaster in 1986, Lee took the INPO model global. Recognizing that "radiation knows no national boundaries," he helped form the World Association of Nuclear Operators (WANO) to improve the safety of nuclear reactors around the world. He served as WANO's president from 1989 until 1991, which helped establish his reputation as a global ambassador for nuclear safety. Lee became so closely identified with progress in nuclear safety, efficiency, and reliability that he was often called "the world's nuclear engineer." But, never one to grow complacent, he often said that "'laurels wilt fastest when sat upon."

To employees at Duke Power, his personal style and strong sense of service and citizenship exemplified Bill Lee's leadership. Nearly every employee who worked at Duke Power during the Lee years has a story to tell. For example, Lee once stopped to help an employee who was having car trouble in the parking lot of one of the power plants—and the employee didn't know until later that the nice gentleman who helped him get back on the road was the CEO. Lee made a point of sitting with an employee's mother on an airplane to let her know what a fine job her daughter was doing for Duke Power. He recalled a casual elevator conversation with a new employee years later—and asked about each family member by name.

The Giver

Bill Lee also embraced the ethic of community service. He never joined a board or accepted a leadership position in name only; he always gave his full energy and attention to the cause at hand. Like his many professional awards and honors, Lee's philanthropic efforts are too many to list. He championed the arts, chairing the fund-raising campaign for the North Carolina Blumenthal Performing Arts Center in Charlotte in 1989–1990. He served as trustee on a number of hospital foundations, volunteered for the Boy Scouts, and was an elder in his church.

Lee was also strongly committed to the economic development of the Charlotte region and the Carolinas. He chaired the Charlotte Chamber of Commerce in 1979 and was appointed by the governor to the North Carolina Economic Development Board and the North Carolina Energy Policy Council.

He had a strong commitment to educational reform, particularly in his home state. He turned down a prestigious board seat at Princeton in favor of a trusteeship at Queens College, telling his alma mater, "I'm honored, but I've got this little college up the street in my neighborhood that needs me more." Lee chaired the Queens College Board of Trustees from 1985 to 1989 and served on the boards of the UNCC Foundation, North Carolina State University's Engineering Foundation, and Johnson C. Smith University Board of Visitors.

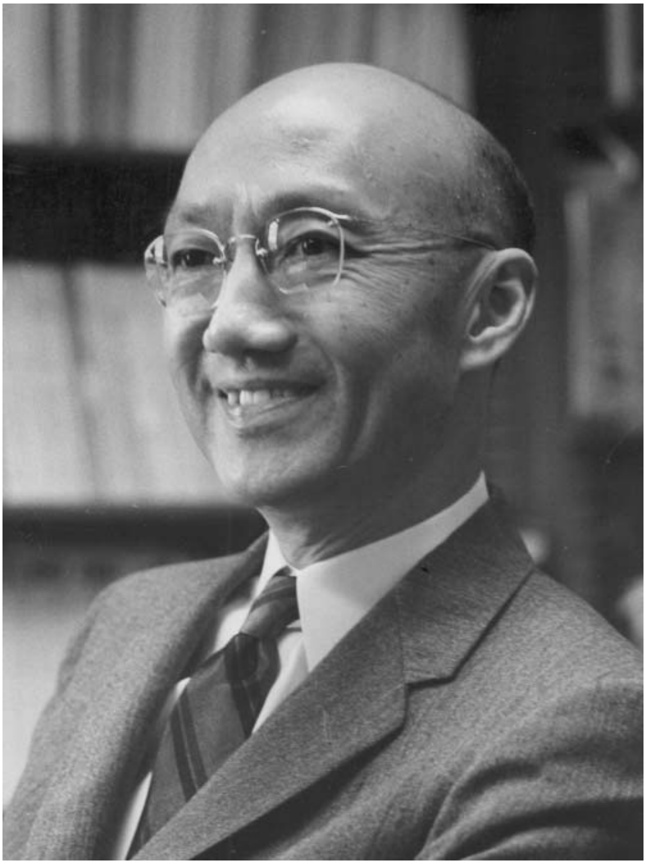
At Duke Power, he established the Power in Education Program to give employees paid time off to volunteer in schools. He sparked the creation of the Charlotte-Mecklenburg Education Foundation to raise funds for innovative programs in the local school system. His commitment to educational excellence led UNCC to name the college of engineering after him in 1994. And the day before he died in 1996, he addressed the North Carolina state legislature, calling for a stronger commitment to education in the state.

Bill Lee was a man of unending curiosity, creativity, and commitment. Of all his pursuits, none was more important to him than his family. He and his wife Janet raised one son, States, and two daughters, Lisa and Helen. His wife and children survive him and live in the Charlotte region, along with five grandchildren: Lisa Lee and Alan Morgan's children Grace and Will; and States Lee's children Madison, States V, and Martin. During the final year of his life, Lee made the grandchildren his priority: fly fishing and horseback riding together in Wyoming; swimming and sailing at Camp Lee, the family homestead on Lake Norman, just a few miles north of Charlotte.

"I love to be really active in the challenge of creating something worthwhile," Lee once said. "Now that could be conquering a mountain skiing downhill, growing a garden, raising money for a charity, or staying on the cutting edge in the pursuit of excellence at Duke Power." The thrill of competition included Lee's leisure interests as well. His family and neighbors remember the "Camp Lee Olympics," which Lee directed every Fourth of July for his extended clan on the shores of Lake Norman. Or, as his wife Jan remembers, the dare of an "even larger garden" every year. Jan recalls that Bill Lee wanted to "leave the world better than he found it" — and that applied to his company, his community, and his family:

"A colleague asked me what I'd most like to be remembered for," he said on another occasion. "My response was, 'a person who helped others achieve more than they could have without me.'"

Life's mission accomplished.



TUNG-YEN LIN

1911–2003

Elected in 1967

"For theory and use of prestressed concrete."

BY KARL S. PISTER, ALEXANDER C. SCORDELIS,
AND EDWARD L. WILSON

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TUNG-YEN LIN, a visionary structural engineer whose pioneering work was internationally acclaimed, died at his home in El Cerrito, California, on November 15, 2003, one day after his 92nd birthday.

Born in Foochow [Fuzhou], China, on November 14, 1911, Lin was the fourth of 11 children of Supreme Court Judge Ting Chang Lin and Feng-Yi Kuo Link. Soon after Lin's birth, the family moved to Beijing, where he was home-schooled until he was 12. He completed his precollege education at Hwei Wen American Methodist School and earned his bachelor's degree in civil engineering from the Jiao Tong University Tang Shan Engineering College in 1931. That same year he began graduate studies in civil engineering at the University of California (UC), Berkeley, where he received his master's degree in 1933. His thesis on direct moment distribution, an important contribution to structural analysis, was the first student thesis published by the American Society of Civil Engineers.

Lin then returned to China and began working for the Chinese Ministry of Railways. He quickly moved up the ranks, and by the age of 25, he was chief bridge engineer of the Chongqing-Chengdu Railway, responsible for the survey, design, and construction of more than a thousand bridges throughout China. In 1941, he married Margaret Kao, whom he had known for a decade.

Five years later, UC-Berkeley offered Lin an appointment as assistant professor of civil engineering, signaling the beginning of his memorable career of academic and professional accomplishment. Professor Lin was an extraordinary man who had a deep love for UC Berkeley. During his tenure, he was chair of the Division of Structural Engineering and Structural Mechanics and director of the Structural Engineering Laboratory from 1960 to 1963. For the 1968–1969 academic year, he was appointed campus-wide Professor of Arts and Science, an honorary appointment to advance interdisciplinary teaching. From 1969 to 1970, a turbulent time on campus, Lin chaired UC Berkeley's Board of Educational Development.

From his earliest days at Berkeley, Lin was willing to teach students at all levels. He initiated new, innovative courses, including courses on the design of long-span bridges and large arenas. An exuberant teacher, his enthusiasm for his subject and his energetic ideas captured the interest of both engineering and architecture students. Even after his retirement, he continued to lecture at the university, fascinating and inspiring students into the twenty-first century.

In 1957, Professor Lin conceived the idea of a holding a world congress on prestressed concrete in San Francisco. An advisory committee was formed, but some of the members were apprehensive about the undertaking; they were finally swayed by Lin's boundless enthusiasm. Leading figures in this new technology from Europe and Asia were invited, and, in a bold move at the time, since the cold war was at crisis level, the committee also invited a delegation from Russia. The week-long congress at the Fairmont Hotel atop Nob Hill was attended by about 1,200 people, many more than the 500 who were expected. The congress was a great success!

In Lin's address welcoming the participants, he presented his now-famous parody contrasting Shakespeare's seven ages of man with the seven ages of prestressed concrete. He stated we were then in its youth with a long and brilliant future ahead. In this, Lin was truly prophetic, and he, himself, was a key figure in making his prophecy come true.

The next, year, the advisory committee was invited to visit Russia, a year before the first cultural exchanges began. The

Russian premier at the time, who was determined to rebuild housing and infrastructure, especially in Moscow and Leningrad, had selected precast, prestressed concrete as the principal building material. During the visit, close professional and personal relationships were established with our Russian colleagues.

Lin's perception that technology could be a means of diplomacy led him to undertake an even more ambitious project—establishing friendly relations between China and the United States. Lin suggested to his former comrades in China that they invite him to visit, the first such technical exchange. Up to that time, the only exchanges had been of ping-pong players. Lin's wife, Margaret, and his daughter were invited to accompany him. Although Lin had been asked to give only five lectures, he actually delivered more than 20 during his month-long trip to Beijing, Shanghai, Hangzhou, Guilin, and Guangzhou. The Lin's homecoming was celebrated by a gathering of their widespread families from many parts of China.

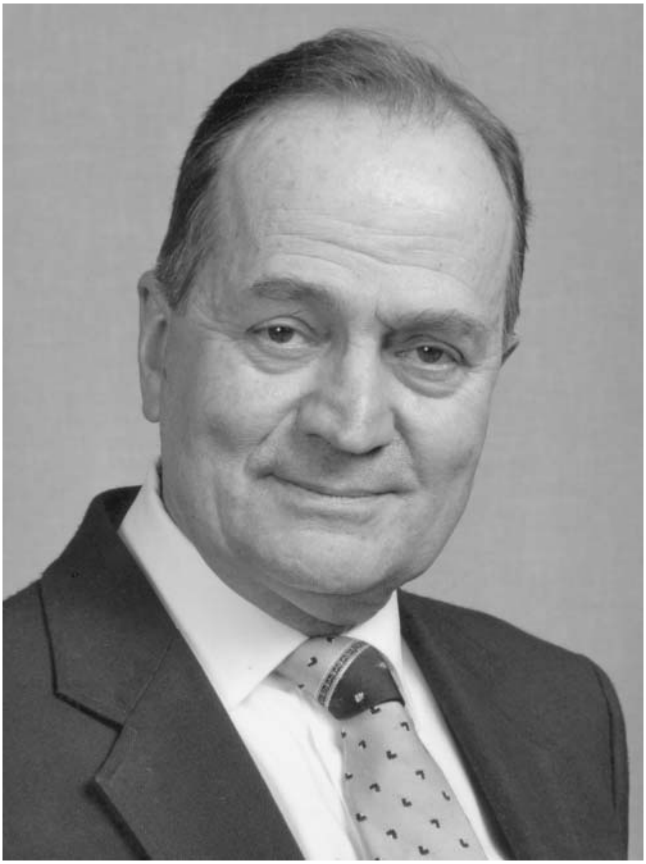
Lin's experience in China reinforced his belief that technology could transform political relations. He then conceived his boldest project yet, his now-famous International Peace Bridge across the Bering Strait, bringing together the Soviet Union and Alaska and the rest of the United States. The bridge captured the imagination and fired the hopes of people around the world. Although the bridge was technically feasible, it was economically impractical and was never built. Nevertheless, it was a huge symbolic success.

Lin conceived of a number of brilliant structures—cantilevered and hyperbolic roof spans extending out over space, tall buildings, and unique bridges—many of them beyond the state of the art at the time. He often sketched his initial ideas on the back of an envelope while flying home from a technical meeting; he would then present them to his colleagues and suggest how analysis and design could proceed. His most remarkable idea was the Ruck-a-Chucky Bridge in California, a curved, cable-stayed bridge hung from two mountainsides. Unfortunately, it has not yet been built, although, like the International Peace Bridge, it fired the imaginations of bridge architects and engineers worldwide. In his many lectures to engineering groups around the world, Lin always conveyed his positive outlook and enthusiasm, inspiring his audience to work creatively with new materials and to approach engineering, a visionary art, in a spirit of creativity.

Beyond his professional career, Lin was an ardent supporter of UC Berkeley. The Lin family and the T. Y. Lin Foundation endowed the T. Y. and Margaret Lin Chair in Engineering, assisted in the establishment of a structural engineering lecture-demonstration laboratory, and endowed fellowships in both structural engineering and architecture.

Among the many honors and awards celebrating Lin's professional achievements are election to the National Academy of Engineering, the 1986 National Medal of Science, Institute Honor Award of the American Institute of Architects, and the Fressinet Medal of the Fédération Internationale de la Précontrainte. Professor Lin also held the distinction of Honorary Member of the American Society of Civil Engineers, the American Concrete Institute, and the Prestressed Concrete Institute.

T. Y. Lin is survived by his wife Margaret, son Paul, daughter Verna, and five grandchildren—Deanna, Katie, and Erik Lin and William and Maxim Lin-Yee.




A S Lodge

ARTHUR SCOTT LODGE

1922–2005

Elected in 1992

"For outstanding monographs and major developments in continuum mechanics, molecular theories of polymer flow, and high-precision measurement of rheological properties."

BY R. BYRON BIRD, A. JEFFREY GIACOMIN,
AND DAVID S. MALKUS

ARTHUR SCOTT LODGE was born on November 20, 1922, in Liverpool, United Kingdom, and spent his childhood there. From 1941 to 1948, he attended Oxford University, where he earned his B.A. in mathematics and his M.A. and D.Phil. in theoretical nuclear physics. He subsequently did experimental work with radar for the Admiralty at the Clarendon Laboratory.

Arthur spent one year (1945–1946) working in the theoretical physics section of the Atomic Energy Division of the National Research Council in Montréal, Canada. This was followed by 12 years at the British Rayon Research Association in Manchester, UK, initially with Karl Weissenberg. Arthur had been introduced to Dr. Weissenberg by his thesis adviser, Professor Maurice Pryce, for which Arthur had been grateful; the introduction enabled him to enter the field of rheology when it was just beginning to blossom—the field he pursued throughout his research and teaching career.

From 1961 to 1968, Arthur held a lectureship in the Department of Mathematics at the University of Manchester Institute of Science and Technology. During those years, he took time out (1965–1966) to lecture and conduct research at the University of Wisconsin in Madison. This resulted in his being invited to return to Madison in 1968 as professor of rheology in the Department of Engineering Mechanics, a position he held until he retired in 1991. From 1969 until 1991, he was founding chairman of the Rheology Research Center Executive Committee at the University of Wisconsin. Even in retirement, he continued to participate in the Friday seminars at the center. Overall, at Manchester and at Wisconsin, he directed the research of 18 graduate students.

Arthur was invited to the University of Wisconsin in response to his first book, *Elastic Liquids* (Academic Press, 1964; Russian edition, 1969; Japanese edition, 1975). In the opinion of Professor R. Byron Bird, this was the first book on rheology that clarified the structure of the subject and established the aims of the discipline. In addition, the "Lodge rubberlike liquid" constitutive equation was introduced and used to solve a wide variety of flow problems. This equation explained everything that could be reliably measured about the linear viscoelasticity of polymeric liquids at that time and for years to come. The book also included an exhaustive study of recoil and an explication of how other more complicated constitutive equations could be developed and tested.

In his second book, *Body Tensor Fields in Continuum Mechanics, with Applications to Polymer Rheology* (Academic Press, 1974), Arthur continued the development of the notion of "body tensors" and introduced techniques for solving classes of problems that had proven difficult to solve. The body-tensor formalism is closely related to the convected-component formalism of J. G. Oldroyd (presented in 1950). Arthur had described the relation between the two types of notation in 1951 and supplied the proof in 1972.

In his next, modest book, *An Introduction to Elastomer Molecular Network Theory* (Bannatek Press, 1999), Arthur presented original ideas about the molecular foundations of elastomer network theory. In the preface he stated: "The distinctive aim of the present textbook is to develop these tools from first principles, in as short, yet complete and self-contained, a form as possible to allow one to illustrate their use by presenting the assumptions and deriving the equations for the simplest form of the molecular network theory of elastomer elasticity." By "these tools," he meant vector and tensor analysis, thermodynamics, and statistical mechanics. In this book, he went out of his way to define all terms and to choose his words carefully. As he liked to say, quoting Lewis Carroll (1872): "When I use a word," Humpty Dumpty said, in a rather scornful tone, "it means just what I choose it to mean—neither more nor less."

In addition to the three books described above, Arthur edited, with Michael Renardy and John A. Nohel, *Viscoelasticity and Rheology* (Academic Press, 1985).

A measure of Arthur Lodge's influence on the field of rheology is the number of terms that bear his name: the Lodge rubberlike liquid; the Lodge network model; the Lodge stressmeter; the Lodge-Meissner relation; the Higashitani-Pritchard-Lodge equation (for the hole-pressure error); and Lodge body tensors.

Arthur Lodge's talents and scientific contributions have been acknowledged in many ways: Fellow of the Institute of Physics, London (UK); Bingham Medal, The Society of Rheology; Visiting Professor, University of Stuttgart Institute of Plastics Technology; Byron Bird Award, College of Engineering, University of Wisconsin; "Citation Classic" for Elastic Liquids; Gold Medal, British Society of Rheology; Olaf Hougen Visiting Professor, Department of Chemical Engineering, University of Wisconsin; and member of the National Academy of Engineering.

Arthur was also involved in a variety of other activities. From 1970 on, he was a member of the Editorial Board of *Rheologica Acta*, and from 1973 to 1984 he was a member of the Working Party on "Structure and Properties of Commercial Polymers," International Union of Pure and Applied Chemistry (IUPAC) Macromolecular Division. In 1981, he formed the Bannatek Company, Inc., to manufacture "stressmeters" (USP 4,454,765, 4,141,252, 3,777,549), instruments used to monitor polymer properties by cleverly using the normal stresses of the polymers. The development of the stressmeter was a tribute to Arthur's skill as an experimentalist.

Most of Arthur's friends have at one time or another been victimized by his cleverly constructed, side-splitting limericks.

He was able to synthesize these literary gems in very short order, much to the enjoyment of all. Arthur's special hobby was piano, particularly the works of Schubert and other romantic composers. He also enjoyed playing chamber music and frequently collaborated with other musicians.

Arthur maintained a Web page devoted to controversial subjects. He particularly enjoyed challenging Darwin-like theories. Other topics he discussed included comparisons of science and religion, types of laboratory experiments, compost temperatures, zero-recoil for the "tube type" of polymer kinetic theories, and "unlikely events" theories.

Arthur and his wife, Helen, had three children: Keith (a professor of chemical engineering at the University of Minnesota-Duluth), Timothy (a professor of chemistry at the University of Minnesota in the Twin Cities), and a daughter, Alison, who lives in England. Their home in Madison was the site of delightful get-togethers for rheologists and students, musical groups, and literary events. The Lodges were always warm-hearted hosts, and their friends enjoyed many an afternoon and evening in their company. With Arthur's passing on June 24, 2005, we lost a solid scholar, a humorous and kindly gentleman, and a thoughtful teacher.

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CHARLES SEDWICK MATTHEWS

1920–2008

Elected in 1985

"For distinguished contributions to petroleum engineering technology and to development of public energy policy in the United States."

BY GEORGE L. STEGEMEIER

DR. CHARLES S. MATTHEWS, Senior Petroleum Engineering Consultant for Shell Oil Company, and an internationally recognized Reservoir Engineer, died in Houston, Texas, on May 8, 2008.

Throughout his 45-year career with Shell, Dr. Matthews had a wide range of accomplishments, first as a technical contributor to the understanding of oil and gas reservoirs, then as a manager / director of research, and finally as an advisor to Shell and to federal and state representative bodies on broader aspects of the energy industry.

Charles Sedwick Matthews was born in Houston, Texas, on March 27, 1920, to James and Zadoc Sedwick Matthews. An early achiever, he received a scholarship to Rice in 1937, and there he was an outstanding scholar (all As) in chemistry and chemical engineering, with a B.S. in 1941, an M.S. in 1943, and a Ph.D. in 1944. After graduation, he joined Shell Development Company in San Francisco, California, and began his career by applying his academic studies of the thermodynamic properties of hydrocarbon gases to the design of refineries and chemical plants.

In 1948, he returned to Houston, where he became one of the 'connate staff' at Shell's new Exploration and Production Laboratory in Bellaire, Texas. Although educated as a chemical engineer/chemist, Matthews easily adapted to the Physical Research Department where physicists were just beginning to do experimental reservoir engineering studies. He applied his knowledge of light hydrocarbon fluids to PVT (pressure-volume-temperature) studies of gas-condensate reservoirs. These studies enabled reservoir engineers to predict behavior, and to operate gas-condensate fields more efficiently.

In the early 1950s, there was a need to understand the macroscopic flow of fluids in oil reservoirs, especially in water flood pilots, where only a few wells were used to determine the feasibility of large-scale projects. Experimental physical models of arrays of wells in fields showed that unexpected migration of oil often occurred during flooding operations. The 19th century 'law of capture' allowed operators to produce oil across neighboring lease lines. This resulted in the wasteful practice of drilling extra wells on close spacing. In the famous Yates Field case, Matthews used model studies to demonstrate to the Texas Railroad commission the need for new laws requiring the unitization of the fields. Unitization allowed fields to be developed with fewer wells and with an equitable sharing of oil reserves. The reserves were based on the geological/petrophysical derived volumes of each owner, rather than on the number of wells or their productivity. In other studies of fluid injection, he examined the effects of gravity drainage on flow patterns.

In 1952, Matthews began his most notable work on developing an understanding of, and methods for, analyzing transient pressure behavior in oil and gas wells. During the next 10 years, pressure transient analysis became Shell's most important tool for observing the behavior of reservoirs. Publication of the first Society of Petroleum Engineers, SPE Monograph, "Pressure Build-up Analysis and Flow Tests in Wells," gained international recognition for Matthews and his co-author, D. G. (Don) Russell.

In 1956, Matthews was chosen to succeed A. F. (Tony) van Everdingen, as Supervisor of Reservoir Engineering Research, and nominally, Shell's Chief Reservoir Engineer. In those years, he provided individual technical guidance for a large group of engineers and scientists and wrote company reports on a variety of reservoir engineering subjects, including relative permeability, pressure build-up, sweep efficiency, and material balance. He also played a major role in establishing Shell's leadership in thermal oil recovery, chemical surfactant flooding, miscible hydrocarbon flooding and carbon dioxide flooding. Initial piloting of these processes often encountered difficulties. Even when things weren't going very well, we never heard a cross word from him. Without his strong research leadership, those processes would have been abandoned and many of the later successes would not have occurred. The success of steam flooding alone has yielded several billion barrels of oil production world wide. Matthews proposed the industry's first CO_2 flood to the Texas Railroad Commission, and his earlier work on miscible flooding contributed to the commercialization of that process.

In spite of the incredible intensity of those years, Dr. Matthews had an easy manner that instilled an atmosphere of understanding and tolerance; however, we all knew it was unwise to go into his office with a weakness in a technical argument. He would surely ferret it out and let you know. He led our group by the technical respect that we all had for him.

In 1965 he assumed greater management responsibilities, successively as Shell's Manager of Petroleum Engineering-Head Office, Director of Production Research, and Shell Oil Engineering Manager. In these positions, he guided the careers of hundreds of young engineers and promoted the very successful concept of a parallel respect in the organization for technical careers as well as for management careers.

In the later years, he became the Senior Petroleum Engineering Consultant, and in that capacity was a highly valued advisor to Shell's top executives. He also became an articulate spokesman for the development of energy policy in the United States. As an early proponent of geothermal energy, uranium (yellow cake) exploration, and tar extraction and upgrading, he was regularly invited to give expert testimony before congressional committees and regulatory and judicial bodies.

In his long career, Dr. Matthews accumulated a long list of honorary memberships, including an unusual combination of scientific and engineering societies: Phi Beta Kappa, Sigma Xi, Tau Beta Pi, and Phi Lambda Upsilon.

He was also honored by the Society of Petroleum Engineers as the recipient of the 1982 Lester C. Uren award for distinguished achievement in the technology of petroleum engineering, an SPE Distinguished Member, a Distinguished Lecturer, a Distinguished Lecturer Emeritus, and a Distinguished Author.

He served on many committees and consulting bodies, including the Department of Energy (DOE) – Fossil Energy Board; Consultant to the DOE; National Petroleum Council (NPC) – Special Assistant on major studies of Enhanced Oil Recovery (EOR) and Unconventional Gas; American Petroleum Institute (API) – Chairman, Reserves Advisory Committee; Interstate Oil Compact Commission (IOCC) – Advisory Committee Tar Sands and Heavy Oil Deposits; Rice University – Engineering Advisory Council; and Chairman, Texas Engineers for Conservation.

In 1985 he was elected to the National Academy of Engineering "for distinguished contributions to petroleum engineering technology and to development of public energy policy in the United States of America."

From Dr. Charles Matthews, the superachieving engineer/scientist, let's now turn to the Charlie Matthews we knew. There are many stories of his flair for living. Always a careful dresser, he often came to work with a boutonnière rose in his lapel, and sometimes brought bouquets of roses for the secretaries. His light-hearted introductory comments became a tradition at our quarterly research meetings with Shell Canada and helped build teamwork in these intense technical sessions. After studying Mandarin for a few months, he delivered his keynote address in Chinese at the World Petroleum Congress in Beijing in 1987. In his obituary, he was described as, " . . . a happy man with a delightful sense of humor. He was a very accomplished yet humble man. Above all, he was a devoted husband." That nicely describes him. He met his wife, Miriam (Rice) in 1944, when they were in school. They were married for 63 years and have two daughters, Joan and Wendy. When Charlie worked in New York, he wrote parts of the famous SPE Monograph while commuting on the train. Miriam reviewed and typed his notes. Charlie said, "It was much better received than my wife predicted — being an English major, she didn't care much for the plot."

Charlie was variously described by his associates as " . . . a man of high intellect, humor, and humanity," ". . . a good friend and mentor over many years," and ". . . a kind, able and talented man!" I consider it a great honor to have worked for him, and to have co-authored my first AIME-SPE paper with him. I was just a summer employee, but he let me make the presentation at the SPE Fall Meeting, and put my name before his on the paper. Charlie was one fine Gentleman!

DWIGHT FOX METZLER

1916–2001

Elected in 1973

"For development of innovative techniques of environmental quality control and wastewater renovation; leadership in water resources and waste management."

BY STANLEY T. ROLFE AND ROSS E. MCKINNEY

BORN ON THE Metzler family farm near Carbondale, Kansas, on March 25, 1916, Dwight Metzler was a true Kansan and a professional engineer of the old school who started at the bottom and worked his way to the very top, accumulating titles along the way. He was a sanitary engineer, chief engineer for the Kansas State Board of Health, executive secretary for the Kansas Water Board, secretary of the Kansas Department of Health and Environment, and chief of water systems development in the state of Kansas. He was also professor of sanitary engineering at the University of Kansas. From 1966 to 1974 he served New York State as deputy commissioner of health and then deputy commissioner of environmental conservation. He even had time for special missions to India and Russia. Dwight Fox Metzler died in Topeka, Kansas, on October 30, 2001, at the age of 85.

Growing up on his parents' farm, Dwight learned early how important weather is to a farmer's success and whether he has a good year or bad year. His early schooling was in a one-room schoolhouse that was typical of rural Kansas. One year, Dwight found himself the only student in his class, as the other two were sick all year long. He went to Carbondale High School and graduated in 1933. The Depression of the 1930s was hard on everyone in Kansas, including the farmers, and Dwight worked on the family farm for three years before going to the Engineering School at the University of Kansas (KU) to study civil engineering. He quickly realized that civil engineering offered a better future than farming.

Dwight was one of the top students in his class when he graduated in 1940. He met his future wife, Lela Ross, at the university, and they were married on June 20, 1941, in Dover, Kansas, on the Ross family farm. Dwight's first job after graduation was assistant sanitary engineer for the Division of Sanitation, Kansas Department of Health, which had been housed on the KU campus in Marvin Hall, with the Civil Engineering Department, since 1909.

As World War II heated up, Dwight Metzler accepted a commission as assistant sanitary engineer in the U.S. Public Health Services Reserve Corps. When he was called to active duty, he was dispatched to Chicago, Illinois, to work with the Federal Public Housing Authority constructing housing for defense workers brought from all over the country. At that time, defense workers had as high a priority as the military, which was in no position to fight a major war without the equipment they produced.

After receiving his discharge from active duty in 1946, Dwight returned to Kansas to work in the Division of Sanitation for the State Health Department. He received his civil engineering degree in 1947 from KU based on his work experience, but he knew he needed further education at the graduate level. In 1947, he gained admission to Harvard University to study sanitary engineering under Professor Gordon Fair.

The Sanitary Engineering Program at Harvard was closely associated with the School of Public Health, and its students received a broad public health education, rather than the engineering-design approach offered at other graduate schools. Dwight received his M.S. in sanitary engineering from Harvard in 1948 and returned to Kansas where he was promoted to the chief engineer's post in the Division of Sanitation. Putting his graduate education to good use, he began teaching courses in sanitary engineering for the Civil Engineering Department at KU.

As chief engineer of the Kansas State Board of Health, Dwight was able to visit regional engineers in the field and see some of their projects. The 1951 flood on the Kansas River was a major disaster, but it gave Dwight an opportunity to develop the leadership qualities necessary to handle a crisis. Under Dwight's direction, people affected by the flood were moved to safe quarters; he then oversaw the repairs to the water supply and wastewater systems.

No sooner had the water distribution systems become operational, however, than the water supplies began to run dry, the result of a five-year drought. The water shortage required that 169 communities restrict their water consumption, which adversely affected about 600,000 people.

When the Neosho River, the source of water for one Kansas town, Chanute, dried up completely in 1956, the city constructed a temporary dam downstream, below the wastewater treatment plant, to capture wastewater effluent. The effluent was pumped above the town's normal water intake pipe and then into the municipal water treatment plant. The use of recycled wastewater effluent lasted about five months and demonstrated that it was possible to survive on recycled wastewater with proper treatment.

The experience of those years had demonstrated that the Sanitation Division needed facilities to conduct research, rather than trying ideas out in the field. Congress had passed legislation to provide 50 percent of funding for health research facilities, and Dwight easily persuaded Dean John McNown and Chancellor Franklin Murphy to back his idea. The university's grant application was approved, and the Environmental Health Research Facility was completed and opened for research in 1961. By that time, the Sanitation Division headed by Dwight had been transferred to Topeka, the state capital, where the rest of the State Board of Health was located.

In 1960, Dwight was invited to India as an international expert to advise the Indian government on water problems and their solutions. He also went to the Soviet Union to evaluate its environmental health programs. In 1962, when the executive secretary of the Kansas State Water Board resigned, Dwight moved into that position. In 1964, he was elected president of the American Public Health Association.

His national exposure caught the attention of Governor Nelson Rockefeller of New York, who, in 1966, persuaded Dwight to leave Kansas and come to New York as deputy commissioner of public health to help develop a large water resources project. The governor put Dwight in charge of the $1.7 billion Clean Waters Program in New York state—quite a jump from Kansas.

In New York, Dwight learned to wear many hats, as problems seemed to multiply. There was the water supply, treatment, and distribution problem; air pollution problems from cars and industrial sites; the problem of wastewater collection, treatment, and return to the environment; and the problem of solid waste collection from every source, processing of solid wastes, and their disposal. In addition, political winds were constantly changing direction.

In 1974, Dwight returned to Kansas as secretary of the newly reorganized Department of Health and Environment. He developed a strong organizational structure for his new department, combining the health and environmental programs in an effective agency that was responsive to the needs of the people of Kansas. He organized statewide emergency medical services, added communication networks, upgraded and trained ambulance personnel, and improved emergency vehicles and equipment.

Dwight developed a physician-recruitment program for underserved areas in Kansas and secured funds from the Kansas legislature for the University of Kansas Medical Center. He restructured the Kansas Crippled Children's Program and completed the first State Health Plan for Kansas. He dramatically increased the number of counties covered by home health services, and during his tenure, the number of deaths from hypertension alone was reduced by 38 percent.

In 1979, a new governor asked Dwight to head the Water Systems Development Program. Dwight was given free rein, but he only had time to bring all of the major stakeholders together and set the ground rules for water development before he reached mandatory retirement age. After retirement, he was always ready to discuss public health and water issues with groups of friends and in "Letters to the Editor" in the *Topeka Capital Journal*. He testified before the Kansas legislature on water quality concerns and spoke in opposition to corporate hog farming in Kansas. He also served as an expert witness at the Love Canal trial.

Dwight Metzler was active in many professional organizations: the American Public Health Association, American Society of Civil Engineers, American Water Works Association, Kansas Engineering Society, Royal Society of Health (in Great Britain), Kansas Public Health Association, and the Kansas Water Pollution Control Association. He was president of the American Public Health Association in 1964–1965, and he received the Crumbine Award from the Kansas Public Health Association, Distinguished Service Award from KU, Distinguished Engineering Service Award from the KU School of Engineering, and Sedgwick Memorial Award from the American Public Health Association. He was elected a member of the National Academy of Engineering in 1973.

Amid the challenges and achievements of his professional life, Dwight shared with Lela a great joy in family life. As parents they were never too busy to help their four daughters with a challenging homework assignment, to encourage music practice, or to attend a sports event. Their daughters' love of nature was nurtured during many excursions to the Metzler family farm, picnics at area lakes, and summer camping vacations in Colorado and South Dakota. As their daughters left home to pursue education and work elsewhere, Dwight and Lela faithfully kept in touch with them through letters, phone calls, and ultimately e-mail. In his last few years Dwight took particular satisfaction from the closeness he observed among his daughters, commenting that anyone who challenged one of them would have to answer to all four. Dwight maintained strong ties to the family farm and drove around its 80 acres on the garden tractor when his legs became unreliable.

His youngest daughter was always relieved when his engineering skills helped him to get out of any situation created by his adventuresome nature.

Dwight and Lela Metzler's four daughters are Linda Diane Metzler, Brenda Metzler Castañón, Marilyn Anne Metzler, and Martha Jeanne Metzler. Their two grandchildren are Gregory David Castañón and Laura Anne Castañón. Lela died in 1991, and Dwight married Helen Telfel in 1998.

Dwight Metzler was a public health engineer of the first order, who raised the traditions of Dr. William Thompson Sedgwick of Massachusetts and Dr. Samuel J. Crumbine of Kansas to a higher level. A true servant of the people, he achieved the rare satisfaction of a good job well done.

HARRY O. MONSON

1919–2007

Elected in 1983

"For outstanding contributions to the design and development of fast breeder reactors and the safety of nuclear power plants."

BY JULIUS D. GEIER, LEONARD J. KOCH, DONALD E. LUTZ, LEONARD MONSON, RALPH W. SEIDENSTICKER, AND WALLACE R. SIMMONS

HARRY O. MONSON, a gifted engineer who made major contributions to nuclear power production, died on May 1, 2007, in Elmhurst, Illinois, at the age of 88.

Harry was born in Chicago on February 21, 1919. He and his wife, Jane Monson (nee Sharpe) formerly of Dixon, Illinois, had two sons, Harry Jr. and Leonard.

As a lieutenant colonel in the U.S. Army Field Artillery in World War II, Harry served with distinction in the South Pacific. After the war, he received his doctorate in thermodynamics and fluid mechanics from Purdue University in 1950.

Harry Monson joined the Reactor Engineering Division at Argonne National Laboratory in 1952. Located near Chicago, Argonne developed the design and operational basis for several types of research and power-production nuclear reactors in the United States. Harry began his career at Argonne in the Naval Reactors Group working on thermal and hydraulics designs for nuclear submarines. In 1955, he joined the Experimental Breeder Reactor II (EBR-II) Project and was soon named project engineer for the entire EBR-II program. In this capacity, he was in charge of engineering work for the design of the primary sodium-coolant system, the fuel element, the reactor-core vessel and support, fuel handling, the reactor vessel, and the reactor containment structure.

The design of EBR-II began in earnest soon after the successful operation of EBR-I, which Argonne built in Idaho in 1951 and which produced the world's first electrical energy from nuclear power. In the early 1950s, as part of President Eisenhower's Atoms for Peace Program, the U.S Atomic Energy Commission initiated the development of a variety of potential reactor concepts for electric power generation (and two basic concepts for submarine propulsion). EBR-II was one of the power reactor concepts selected for development.

Two light-water reactor concepts were also selected—pressurized-water and boiling-water reactors. EBR-II was a 20 MWe fast sodium-cooled nuclear reactor facility located near Idaho Falls, Idaho, that began electrical power operation in 1964. The EBR-II facility included an onsite fuel-recycling facility that took spent fuel from EBR-II and reprocessed it for direct return to the reactor.

This ambitious and complex undertaking was very successful, and the innovative design of EBR-II was the basis for many of the world's sodium-cooled fast reactors. Although designed initially as an experimental facility, it ran continuously for 30 years, producing electrical energy and copious amounts of data important to the design of fast reactors and fast-reactor safety, as well as demonstrating the feasibility of onsite fuel recycling.

Harry's technical and leadership skills contributed significantly to the success of EBR-II. The detailed design of the primary system was in large part attributable directly to his engineering talents and leadership. Talented, meticulous, precise, and highly motivated, he set high standards for himself and required similarly high standards of his associates. No design detail was too small or too complex to escape his thorough review. His range of knowledge encompassed the entire scope of engineering activities of the sodium-cooled fast reactor. At the end of the EBR-II Project he was undoubtedly one of the country's outstanding engineers in the field of sodium-cooled fast-reactor design.

Harry epitomized the saying that "if something is worth doing, it is worth doing right." He was also very analytical and thus was able to evaluate new concepts and new technologies. His demand for high standards caused some supervisory difficulties but also produced desirable results. The work for which he was responsible might have been delayed sometimes, but the delay always resulted in a more accurate design and contributed to the long life and reliable operation of EBR-II.

As project engineer for the Nuclear Island portion of the EBR-II nuclear power plant, he led the development and application of many new and unique engineering concepts in a radically new technology. His constant drive to "do things right" resulted in the continuous asking of "what if" questions and the evaluation of many hypothetical circumstances and their consequences. As a result, the design included many conservative features, which, although they were never needed during the 30-year operating life of the plant, provided a high level of confidence that advanced the experimental investigations that continued throughout the long life of the facility.

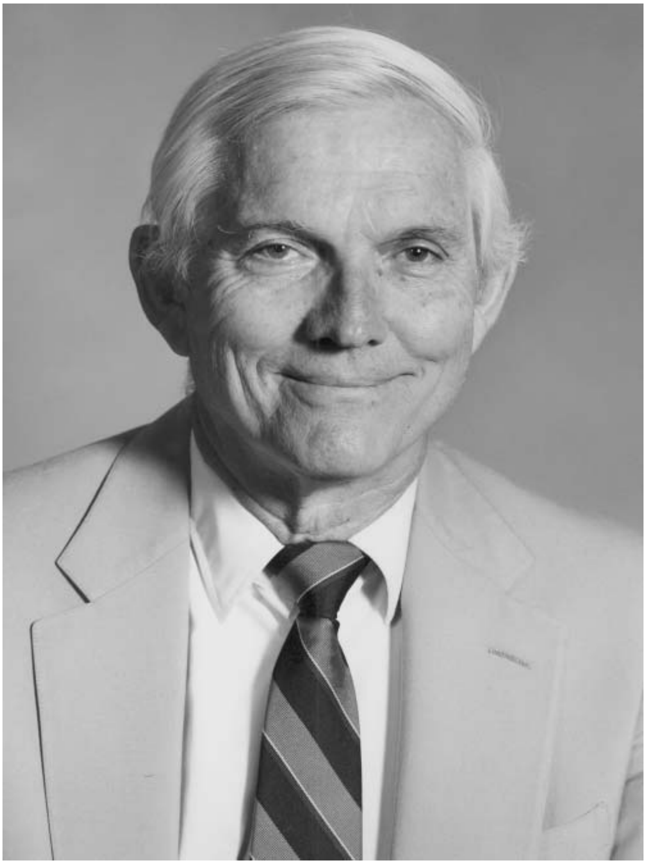
Harry's personal characteristics also served him well later in his career as a member of the Advisory Committee on Reactor Safety (ACRS). This important group, which operates independently of the Nuclear Regulatory Commission (NRC), provides expert oversight of nuclear facilities to ensure their safe operation and identifies questionable features of their design and operation. The "what if" approach, used by ACRS at Harry's urging, was extremely successful.

Harry Monson came up with far-ranging innovations to solve complex, often unprecedented problems in nuclear-reactor technology. He demanded exhaustive and sophisticated confirmation of concepts using simulation modeling, supporting research, and, above all, convincing proof of fail-safe designs. Harry held himself and his associates to strict standards for safety, quality, and dependability and insisted on straightforward, unambiguous translations of research results into useful, accurate design bases and working systems.

Harry was not only a first-class engineer, but he also led a first-class life. He and his wife, Jane, were avid tennis players, who played the game as often as they could, sometimes several days a week. Harry was also a seasoned world traveler. In his later years, someone overheard him say he had visited 112 countries, and that person suggested that Harry was either exaggerating or his memory was not as good as it had been. Not so, says one of Harry's sons. Harry indeed traveled to 112 countries, almost always accompanied by Jane.

On one trip, they found themselves sitting on a park bench in Hong Kong taking a break from sightseeing. Suddenly, Harry, who was passionate about ice cream, said he wanted to find the best ice cream Hong Kong had to offer. Harry told Jane to wait while he went off to find this treasure. After almost an hour, he returned and informed Jane that he had been told that the best ice cream anywhere was not in Hong Kong but in New Zealand! They got up, went back to their hotel room, booked a flight to New Zealand, and checked out of the hotel. Harry was a world-class traveler, as well as a world-class engineer.

He is survived by his sons, Leonard Monson, Batavia, Illinois and Harry O Monson, Lisle, Illinois; two grandchildren (Len's) JaneAnn (15) and Eric (14); a brother, Morton Monson, Phoenix, Arizona; and a sister, Willa Debish, Park Ridge, Illinois.



JOSEPH B. MOORE

1926–2006

Elected in 1986

"For contributions to the technology of rapid solidification, and for the development of gas-turbine-engine materials.

BY BERNARD L. KOFF

JOSEPH MOORE, one of the nation's foremost leading pioneers in materials development for gas turbines and rocket engines, died on January 7, 2006, at the age of seventy nine. Prior to retirement in 1991, he served as Director, Materials Engineering & Technology, Pratt & Whitney Group, United Technologies Corp. His career spanned 37 years. He was renowned worldwide for his contributions to the science and processing of materials which led to major improvements in turbine and rocket reliability and operability. He is survived by his sister, Jane Kiger, and by his sons Robert and Albert, and daughters Donna, Katherine, and Nancy.

Joe grew up in Tuscaloosa, Alabama, was an avid sports fan, attended prep school at Baylor, and entered the V-12 program at Rice before serving in the Navy. He is a graduate of University of Alabama with a B.S. in Aeronautical Engineering (1948) and an M.S. in Mechanical Engineering (1955). He specialized in Metallurgy and Materials Engineering, was a devoted University of Alabama football fan and a music lover of both opera and old time jazz.

His career started with the General Electric Aircraft Engine Division in 1954 as a metallurgist, focusing on an emerging new class of materials known as heat-resistant, precipitation hardening superalloys. His particular interest was to understand the relationship of microstructure to thermal exposure and mechanical strength, and how alloying and processing could alter behavior. The alloy René 41, still considered to be a workhorse high-temperature material for forged turbine components, was a result of his early exploits. Recognizing that this class of materials was yet in its infancy, he joined the Wyman-Gordon Co. in 1957 as Supervisor of Vacuum Melting to understand process behavior. In 1960, he joined the Southern Research Institute as Senior Scientist to further his knowledge of microstructure-property relationships. During this time, he integrated the use of statistical analysis to determine behavioral trends from what was known as partial factorial experimentation — a means whereby large dimensioned experimental grids could be reduced in size to shorten the time and cost of data acquisition.

In 1961, opportunity knocked with the opening of Pratt and Whitney's Florida Research and Development Laboratory — a facility dedicated at that time to develop technologies for new concepts in rocket and jet engines. Joe's expertise was perfect for this need and he joined as Metallurgical Supervisor with the immediate task of organizing and equipping a team to develop materials which could operate 200ºF–600ºF hotter than ever before. A natural born leader, Joe proactively worked with engine designers, manufacturers, and project engineers to clearly define and understand requirements to advance the state of art in materials set against specific goals. The results were dramatic and the materials contributions were subsequently cited as "key enabling technologies." These technologies were used in the successful development of the revolutionary, continuously afterburning J58 power plant used in the Mach 3+ SR-71 reconnaissance aircraft, best known as the Blackbird.

In 1976, Joe was promoted to Director, Materials Operations and held this position with increasing responsibility until retirement. His organization grew as did his acclaim. Some of his more well-known accomplishments include:

- precision, equiaxed superalloy castings for improved strength and heat resistant turbine airfoils
- ingot casting and forging procedures to ensure rim-to-bore property uniformity for large turbine disks

- adaptation of highly innovative inert gas powder metallurgy technologies to reduce process defects leading to fatigue in complex heat resistant alloys
- alloying and processing superalloys to retard crack propagation in highly stressed turbine components subjected to high cyclic strain
- superplastic forming of otherwise unworkable superalloys for engine components, and
- rapid solidification to enable alloying of metals without chemical segregation.

The equiaxed cast alloy IN 100 was first used for the J58 engine turbine blades at a time when cast turbine blades were not considered useful because of low fatigue strength. Multiple forging procedures were also developed to provide uniform cross-section strength for Astroloy which was the strongest but difficult to forge superalloy turbine disk material. Inert powder processing went on to become the foundation corner stone for all superalloy powder metallurgy engine components.

Superplastic deformation enabled forming superalloys otherwise impossible to forge, and opened the door for alloys with higher strength, ductility, and resistance to fatigue. This innovative isothermal forging process was named "Gatorizing" and produced the first successful powder metallurgy turbine disks operated in a gas turbine. Joe assigned this name to honor the Florida alligators roaming outside the facility and so that people would remember where it happened. The high bypass PW-4084 turbofan engine for the B-777 aircraft uses "Gatorized" processing for the uncooled low pressure turbine driveshaft to develop the torque to drive the fan and low pressure compressor.

Mr. Moore and his colleagues continued to develop and experiment with rapid solidification to further advance alloys in aluminum, iron base materials, and nickel superalloys. Considerable effort was made to produce a non-oxidizing Niobium alloy for uncooled turbine blades operating at 2700°F but was not successful. However, the rapid solidification process was successful in developing a non-burning titanium alloy for jet engine components up to 1200°F, some 500°F higher than current titanium alloys.

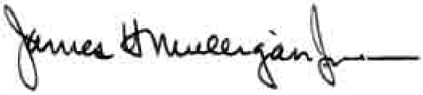
I'm sure that if Joe were here today, he'd want to try again to produce a turbine blade alloy higher than 2400°F which is the incipient melting temperature for current nickel based alloys.

In 1972, Pratt & Whitney presented the George Mead Gold Medal for the invention of Gatorizing to both Joe and his close associate Roy Athey. The Air Force considered this among the most significant developments in the past 60 years. In 1986, Joe was elected to the National Academy of Engineering for his contributions to metallurgy and materials processing.

Mr. Moore holds 6 patents used worldwide and produced 12 publications associated with gas turbine and rocket engine applications.

He was a member of the American Society for Metals and served on numerous government, university, industry boards, and committees including the National Research Council. He also provided support to universities for curriculum guidance in metallurgy and related subjects.

Mr. Moore was a very practical "hands on" engineer who displayed great insight of current situations which provided a key to his pioneering foresight. One of his comments was "seeing is believing" when presenting to the metallurgical community the results of his research and development. He was a joy and inspiration to work with.



JAMES HENRY MULLIGAN, JR.

1920–1996

Elected in 1974

"For contributions to electrical network theory and to system theory and applications."

BY WILLIAM W. LANG

JAMES HENRY MULLIGAN, JR., the second Secretary of the National Academy of Engineering and its first Executive Officer, died on January 12, 1996, in his 75th year. With his broad range of interests, Jim had a distinguished career of service to the electrical engineering profession that spanned more than a half century as teacher, mentor, and technical leader.

Jim was born in Jersey City, New Jersey, on October 29, 1920. He received BEE (1943) and EE (1947) degrees from Cooper Union School of Engineering, an M.S. degree in electrical engineering in 1945 from Stevens Institute of Technology, and a Ph.D. degree in electrical engineering in 1948 from Columbia University. He subsequently pursued postdoctoral studies in mathematics and physics at Columbia University and New York University. His career included major engineering responsibilities in industrial, government, academic, and professional organizations.

Jim's first employment was as a member of the technical staff in the transmission development department of the Bell Telephone Laboratories and later as a member of the Combined Research Group of the Naval Research Laboratory contributing to the development of the Mark V radar IFF (Identify Friend or Foe) system. At the conclusion of World War II, he joined the Allen B. DuMont Laboratories where he was initially concerned with research and development on portable and studio television camera and video equipment and subsequently was chief engineer of the television transmitter division. From 1949 to 1968, he was a member of the faculty of the Department of Electrical Engineering at New York University, serving as chairman of the department from 1952 to 1968.

His research centered on the design methodologies for electronic circuits and the development of analytical methods which underlie them. He worked on the design of electrical systems with lumped elements and distributed elements in combination that established the foundation for the design of analog electronic circuits with prescribed performance characteristics in many different applications. This methodology was responsible for state-of-the-art improvements in radar, television, and IFF systems. He also researched the systematic assessment of the quality of computer-aided designs for VLSI (Very Large Scale Integration) integrated circuits. For his technical contributions and his leadership of professional engineering societies, he was elected a member of the NAE in 1974.

In 1968, Jim moved to Washington to join the NAE as a full-time member of the staff in the position of secretary, succeeding Harold Work who had been the secretary from its founding in 1964. In 1958 Work, then associate dean of New York University's College of Engineering, proposed the very first concept that lead to the founding of the National Academy of Engineering, but it wasn't until December 5, 1964, that the new Academy was born. Work became its first secretary. The decade following NAE's founding has been described in the "The Making of the NAE — The First 25 Years" as a decade of turmoil. As its secretary during the latter part of this decade, Jim was a witness to this turbulent era during which there were several reorganizations as the NAE struggled for autonomy within the National Academies' complex. The NAE Council recognized Jim's talents and effectiveness by appointing him the first NAE Executive Officer in 1968. By 1974, four presidents had occupied the office (Augustus Kinzel, Eric Walker, Clarence Linder, and Robert Seamans); and an acting NAE president (William Shoupp) was in the office as a search committee sought a replacement for

Seamans. Quoting from the above publication, "Not only would it be difficult to replace a man of Seamans' extraordinary qualifications and do it rapidly, but as James H. Mulligan, Jr., then Executive Officer of NAE noted, the position required someone who could deal comfortably with the multiple constituencies of industry, government, and academia represented by the Academy membership."

One of the unwritten principles of the NAE president and Executive Council was that no staff member should be elected to membership in the Academy. Harold Work, Jim's predecessor as secretary, played an important role in the formation of the Academy, became its first secretary, but was never elected to membership. Nonetheless, a small group of NAE members who were either serving on the NAE Council at the time or had served on it earlier, led by J. Ross Macdonald, recognized Jim's many professional accomplishments and successfully proposed him for NAE membership. Jim was the only NAE staff member who was not an NAE member at time of appointment ever to be elected to membership in the NAE.

Jim's participation in the activities of the Institute of Electrical and Electronics Engineers (IEEE) and its predecessors, the American Institute of Electrical Engineers (AIEE) and the Institute of Radio Engineers (IRE), extended throughout his professional career. In the late 1940s and the 1950s, he served as a section officer as well as a member or chairman of numerous technical committees. In the early 1960s, he was active in IRE technical activities, notably those dealing with circuit theory, and carried these volunteer activities into the merged organization, the IEEE, formed from the AIEE and the IRE in 1963. He served as vice president for IEEE technical activities in 1968 and 1969, was elected IEEE vice president in 1970, and served during 1971 as IEEE president. Jim is recognized within the IEEE as having been the principal architect for the organizational structure of technical activities within the institute. He was instrumental in changing the composition of the IEEE board of directors so that each technical specialty within the IEEE was properly represented on its board. After his presidency, he became the IEEE vice president responsible for regional affairs in which role he worked diligently during the latter part of the decade of the 1970s to improve the regional structure of the IEEE membership.

In 1974, Jim left Washington to become the dean of the School of Engineering and professor of electrical engineering at the University of California, Irvine. During his first years in California, Jim continued to serve as secretary of the NAE on a part-time basis until 1978.

When he completed his term as dean in 1977, he continued as a professor in electrical engineering until his retirement from UC Irvine in 1991. He specialized in circuit theory and in designing and implementing courses in VLSI with responsibilities for the curriculum in this area. Jim was noted in his UC Irvine biography as being a "tough and thorough taskmaster demanding high performance and exacting perfection." From his students he demanded professional assistance, and immediate response from his staff. Although he was serious and formal with regard to his academic and professional activities, he loved people and enjoyed entertaining them in his home. He had a large blue automobile which aged into an unsightly "blue bomb," the paint faded and peeling with evidence of many scrapes. He delighted in driving his bomb to exclusive restaurants in his neighborhood and requesting valet parking.

During his career Jim received many honors. In addition to membership in the NAE, he was elected to the American Association for the Advancement of Science. He was a fellow of the IEEE and the IEE (London). He was the recipient of many prestigious awards: the 1974 IEEE Haraden-Pratt Award; the 1978 Professional Achievement Award of the IEEE United States Activities Board; the 1984 UC, Irvine, Lauds and Laurels award for professional achievement; the 1986 Distinguished Service Award of the IEEE Circuits and Systems Society; the 1986 Meritorious Service Award of the IEEE Education Society; the 1987 Linton E. Grinter distinguished service award of the Accreditation Board for Engineering and Technology; the 1988 ABET Fellow Award of the Accreditation Board for Engineering and Technology; and the 1988 Benjamin Garver Lamme award of the American Society for Engineering Education. He also received several prize paper awards from the AIEE and the IEEE.

The IEEE James H. Mulligan, Jr., Education Medal was established in 1956 by the AIEE and continued by the IEEE board of directors to honor the past IEEE president. Presented annually for an exemplary career in education, the medal recognizes the importance of the educator's contributions to the vitality, imagination, and leadership of the members of the electrical engineering profession.

Jim was married to Jeanne, his wife of 49 years, and is survived by their two sons, James III and Richard.

Those who had the privilege of knowing Jim Mulligan will remember him as a warm person and a hard-driving team leader who accomplished much to shape the professional organizations in which he was an active participant and driver. His accomplishments are an inspiration to future generations of electrical engineers.

FRANK REGINALD NUNES NABARRO

1916–2006

Elected in 1996

"For contributions to the understanding of crystal plasticity."

BY ALI S. ARGON

FRANK REGINALD NUNES NABARRO was born on March 7, 1916, in London, England. He received his early schooling in Nottingham and, in 1934, went up to New College, Oxford, to study physics. Recognizing that his strength was in theory, he proceeded to take first-class honors in mathematics and physics.

Early Career

In a very real sense, Nabarro was "present at the creation" of dislocation theory of crystal plasticity, and he continued to be a primary contributor to this important area of physics and materials science. Guided by Nevill Mott, a future Nobel laureate, in 1940 he published the first quantitative model of the flow stress of crystals hardened by a solid solution. To show the importance of the flexibility of dislocation lines in sampling solute atoms on the glide plane, he introduced the concept of "line tension" of dislocations, an important tool in dislocation theory in problems of flow stress.

During the Second World War, Nabarro worked for the British Army Operational Research Group (AORG) headed by Brigadier Basil Schonland, who later became the first president of the South African Council for Scientific and Industrial Research. Schonland later played an important part in recruiting Nabarro for the University of the Witwatersrand (Wits) in Johannesburg. For his wartime services, Nabarro was awarded the Member of the Order of the British Empire (MBE) in 1946.

After the war, Nabarro resumed his academic career in Mott's group at Bristol University, as a Royal Society Warren Research Fellow. During his Bristol period, he made important advances in the theory of metal plasticity and dislocation theory of work hardening. He also pioneered the landmark development referred to as "diffusional flow" independent of the work of Herring. Other firsts during this period included collaboration with F. C. Frank and J. D. Eshelby in considering dislocation pile-ups that were thought to play an important part in work hardening of crystals and in fracture. He also provided a fundamental reevaluation of the model of Rudolph Peierls for the lattice resistance to slip, referred to since as the "Peierls-Nabarro force."

In 1948, Frank Nabarro married Margaret Dalziel, who had been Schonland's personal assistant. In 1949, he joined Birmingham University to take up a lectureship in the Metallurgy Department. While at Birmingham, he published the first definitive review of the mathematical theory of stationary dislocations. In recognition of his considerable achievements, Birmingham University honored him with a D.Sc. in 1953.

The Move to South Africa

In 1953, in response to personal inducements by Schonland, Nabarro moved to South Africa to head the Department of Physics at Wits, where he built up the Physics Department to considerable strength in several areas. He often advised students on their experimental work, but he was at his best, as always, on theory. If an elaborate calculation had been performed, he quickly recognized anything that was false or incorrect.

Even though the responsibilities of running a department took him out of the scientific mainstream for some years, through prodigious effort he remained on the cutting edge of his field. During those years, he returned to the writing of his monograph, *Theory of Crystal Dislocations,* which was published by Clarendon Press: Oxford, in 1967. The book was an important resource on basic concepts for many years.

As the demands of his position as department head eased, Nabarro was able to devote more of his time to research, and over the years, he contributed key ideas to many areas of dislocation physics. In later years, he turned his attention to quasi-crystals, dislocation patterning in plastic deformation, and creep-resistant materials and rafting in superalloys. The latter interest eventually resulted in his more recent monograph, *The Physics of Creep*, (CRC, 1995), which he wrote in collaboration with deVilliers.

In 1961, Nabarro became the director of the Solid State Physics Research Unit (SSPRU) of South Africa, which was responsible for coordinating sponsored research activities at universities in collaboration with industrial research organizations. From the outset, the activities of SSPRU were divided between basic physics and projects with a direct bearing on the South African economy.

In the 1970s, after a short stay in Orsay, France, Nabarro developed an interest in liquid crystals and in the role of dislocations and disclinations in biological materials. This led, among other things, to an analysis of the structure of an insect muscle and its flexure, which appears to have anticipated the ideas of some biologists and, later, during a sabbatical leave in Berkeley in 1977, to a successful mechanistic description of the crenation of red blood cells by drugs.

Nabarro often passed on Mott's advice to young researchers: "Try to get a mental picture of what is going on, then find the simplest theory that contains the essential facts. When things become complicated, leave the details to someone else." Nabarro knew his limits and was always open to contributions from people whose skills complemented his own.

Nabarro served Wits in various capacities, including a term as deputy vice chancellor during which, in 1981, he drew up an Academic Plan, the first for any South African university, which anticipated a large influx of black students after the end of apartheid. His support never wavered for opening the doors of academe in South Africa to everyone who could benefit from higher education. In his graduation address to the University of Natal on April 28, 1988, he expressed his contempt for the Separate Universities Act: "The biggest blow that the government struck at the liberal universities of South Africa in 1959 was to deprive us of our right to be . . . " He often voiced his belief that a university was a community of scholars and should be governed in a collegiate way, a view that differed somewhat from the later ethos that often valued more quality-control audits, and the like.

Nabarro was an inspiring teacher and mentor. A generation of physics graduates from Wits remembers fondly evening sessions at his home, where the human side of physics was revealed. His lectures were challenging and forced students to think. Through them, students saw that physics was not cut and dried, but an open-ended, evolving subject.

Retirement, Honors, and New Opportunities

Nabarro retired in 1984 but remained an active member of the Wits community, always generous with his time and wise counsel. Loyiso Nongxa, vice chancellor of Wits, in a farewell tribute to Nabarro, declared, "He was an inspiration to generations of scientists, and he had a significant influence on the thought and direction of this university. He was renowned for his brilliant mind, sharp intellect, meticulousness, and his unique sense of humor." Nabarro always cared deeply about South African people and their future.

Nabarro was elected to the Royal Society (London) in 1971. He was elected an honorary fellow of the Royal Society of South Africa in 1973 and served as its president from 1988 to 1991. He was a council member of the South African Institute of Physics for a number of years, and a vice president from 1988 to 1991. He was also a member of the Science and Engineering Academy of South Africa.

In 1966, he was elected a foreign associate member of the U.S. National Academy of Engineering, the only member on the African continent. In recognition of his local stature, he was awarded the South African Presidential Decoration of the Order of Mapungubwe. Among other honors, he was also the recipient of honorary doctorates (D.Scs) from Wits, University of Cape Town, University of Natal, and University of Pretoria.

Nabarro held visiting positions at several universities in the United States, Canada, and the United Kingdom. He was the recipient of numerous awards, including the De Beers Gold Medal of the South African Institute of Physics, the Platinum Medal from the Institute of Materials, and the R. E. Mehl Award of the The Minerals, Metals & Materials Society (TMS) in the United States. Festschrifts in his honor were published by the Royal Society of South Africa in 2003 and by *Philosophical Magazine* in 2006.

Nabarro was not only an outstanding scientist, but was also a well-informed, cultured man. He shared a love of classical music with his wife Margaret, who was a notable musicologist. He was honorary president of the Johannesburg Musical Society, and in memory of Margaret, he established the Margaret Dalziel Nabarro Chamber Concert Fund.

Nabarro had an uncanny ability to get along with people across the political spectrum in South Africa. Many people admired him most for his sheer lust for life, his phenomenal energy and resilience, and his extraordinary intellectual vitality. He traveled extensively, attending conferences and giving lectures wherever he went. In the United States, he attended the Gordon Conferences on Physical Metallurgy for many years, many topical conferences of the TMS, and symposia of the Materials Research Society. Just months before his death, in spring 2006, in spite of serious health problems and a painful broken foot, he visited India and China. When he passed away on July 20, 2006, he was editing volumes 13 and 14 of *Dislocations in Solids,* a series of books he had edited over the years. His mind remained razor sharp to the end.

Acknowledgment

I am grateful to Professor Arthur Every of the Department of Physics of the University of the Witwatersrand, Johannesburg, South Africa, for his help in preparing this tribute.

Further Reading:

A. G. Every's obituary, "Frank Nabarro: A journey through science and society," *S. African J. Science,* 103, 99-103 (2007).

DANIEL A. OKUN

1917–2007

Elected in 1973

"For innovative contributions to sanitary engineering and to teaching and research."

BY PHILIP C. SINGER

DANIEL A. OKUN, Kenan Professor of Environmental Engineering, University of North Carolina (UNC), Chapel Hill, was hailed worldwide for his groundbreaking discoveries and for the protection of pristine water sources, water-resources management, water reclamation and reuse, watershed protection, and technologies and institutional solutions to water-supply and wastewater management in developing countries.

During his long career, Dan worked in 89 countries and was a consultant to municipal and legislative planning committees throughout the United States. He helped design a water-treatment plant in Bangkok, Thailand; established a graduate program in sanitary engineering in Lima, Peru; and studied water supply and pollution control in China for the World Bank. At home in Chapel Hill, he led a campaign to build Cane Creek Dam and Reservoir in the 1980s to ensure that the UNC campus and the city of Chapel Hill would have the highest quality drinking water.

Dan, with his wife Beth, was also an active participant in a variety of social causes related to the rights of disenfranchised people and communities. In the mid-1960s, they both worked to fight to abolish segregation and ensure racial integration in Chapel Hill. In the early 1970s, they were outspoken critics of the Vietnam War, and as chair of the Faculty Senate at UNC, Dan helped maintain order during that difficult period.

In the words of Barbara K. Rimer, dean of UNC's School of Global Public Health, "Dan Okun cared deeply about his school, his community, his state, and his world. And he turned that commitment into action, whether through water projects or social action. Few professors have influenced more students, more professionals, or more policy decisions around the world than Dr. Okun. His work has influenced international policy making for organizations like the World Bank, United Nations, and the World Health Organization. There is nowhere I go that people don't talk about Dan with awe," she said. "Dan was a model citizen/professor, and I am so glad to have known him."

Okun began his career at UNC in 1952; he was chair of the Department of Environmental Sciences and Engineering from 1955 to 1973. Under his leadership, the department faculty increased from three to 25. Although he retired from teaching in 1982, he remained actively involved in the profession for the rest of his life through writing, lecturing, and consulting.

"Dan influenced generations of environmental engineers and public health professionals with his clear thinking and equal clarity of purpose," said Michael D. Aitken, chair of the School of Global Public Health Department of Environmental Sciences and Engineering. "His life's work on water supply and, more recently, on water reuse earned him an international reputation that few attain. His humanity equaled his professional stature—from his concern for safe drinking water in developing countries to his engagement in local social issues to his model service as an academic citizen at this university."

Okun was the first engineer from North Carolina elected to the National Academy of Engineering and later to the Institute of Medicine. He chaired the Water Science and Technology Board of the National Research Council from 1991 to 1994 and served on many committees and councils of the U.S. Public Health Service, World Health Organization, Pan American Health Organization, and National Academy of Sciences, among others. Among the many awards he received were the Association of Environmental Engineering and Science Professors (AEESP) Founders' Award, the American Academy of Environmental Engineers (AAEE) Gordon Maskew Fair Award, the American Society of Civil Engineers (ASCE) Simon Freese Award, the Water Environment Federation (WEF) Gordon Maskew Fair Medal, the American Water Works Association (AWWA) Abel Wolman Award of Excellence, the Environmental Water Resources Institute (EWRI) Lifetime Achievement Award, and the International Water Association (IWA) Grand Award. In August 1999, *Engineering News-Record,* in honor of its 125 years of publishing, named Okun one of the top 125 engineers who "singularly and collectively helped shape this nation and the world."

In June 2007, Okun celebrated his 90th birthday with a party at the Carol Woods Retirement Center in Chapel Hill. More than 220 people came that day to offer their warm wishes and to celebrate the life of their friend and colleague. Just six months later, on December 21, 2007, many of them returned to the retirement center for a memorial service in his honor.

As Michael Aitken said, "I believe Dan's greatest legacy will be this Department of Environmental Sciences and Engineering. He transformed it from a traditional program in sanitary engineering to the multidisciplinary department we are today, at a time when this was unheard of. He was truly a man of vision who pushed us to excel even through the last years of his life. We will miss his wisdom; we will miss him."

Dan was a pioneer who profoundly influenced scientific, technical, and policy advancements in the field of environmental sciences and engineering. An engineer's engineer, he cast a giant shadow on the broad field of water-supply and water-resources management, and he will be greatly missed by the many students, faculty, and professionals with whom he worked at home and abroad. His legacy will surely live on among all engineers and scientists dealing with issues of water and health.

To commemorate his life's work and his contributions to engineering and water-resources management in developing countries, the UNC chapter of Engineers Without Borders was renamed the Dan Okun Chapter of Engineers Without Borders.

His daughter wrote: "Daniel Alexander Okun was the son of Will and Leah Okun, immigrants from Belarus; he grew up in Brooklyn, NY. He met Beth Griffin in New Orleans when he was in the Army and she was a social worker. The couple married and spent more than six decades together traveling the world, raising a family, and serving their Chapel Hill community. Dan was beloved by his family for his wonderful sense of humor, his firmly held beliefs, and his activism. He was an extraordinary father and grandfather who taught well his values of honesty, integrity, and community involvement. He is greatly missed.

Dan is survived by his brother, Milton Okun; his son, Michael Okun; his daughter, Tema Okun; and his grandsons, Will and Joedan Okun.

RUSSELL RICHARD O'NEILL

1916–2007

Elected in 1975

"For contributions and leadership in the fields of engineering education, maritime cargo handling systems, and marine transportation engineering."

BY VIJAY K. DHIR

RUSSELL R. O'NEILL, professor and Dean Emeritus of the University of California, Los Angeles (UCLA) Henry Samueli School of Engineering and Applied Science, joined the UCLA engineering faculty in 1946 as one of its first members and remained with the school for more than 60 years. In 1975, he was elected to the National Academy of Engineering "for contributions and leadership in the fields of engineering education, maritime cargo handling systems, and maritime transportation engineering." He died in Sherman Oaks, California, on October 11, 2007.

Russ was born in Chicago on June 6, 1916, but the family soon moved to Los Angeles where he spent most of his life. In 1934, he entered the pre-engineering curriculum at UCLA, then transferred to UC Berkeley, where he completed his bachelor's (1938) and master's (1940) degrees in mechanical engineering.

In the early 1940s, Russ began a career as a design engineer with Dow Chemical in Midland, Michigan. In 1944, he returned to Los Angeles, where he joined the war effort working at AiResearch. At the end of World War II, he was offered a faculty position at UC Berkeley contingent upon his completion of a

Ph.D., but he decided instead to follow Professor L.M.K. Boelter to the new College of Engineering at UCLA. His first appointment, in 1946, was as lecturer and representative of the UCLA Engineering Extension. Concurrently, he completed the Ph.D. course work

Russ also directed the off-campus master's degree program at UCLA In the decade following World War II, the program, which offered classes in San Diego, Orange County, Port Hueneme, and at the Naval Ordnance Test Station in the Mojave Desert, was the only master's degree program in southern California outside of Los Angeles. It offered complete graduate programs taught by regular UCLA faculty in residence. Once engineering programs became available at other UC and California State University campuses, the off-campus program became largely redundant, but for nearly a decade, it served a valuable purpose.

Russ' research interests were in maritime cargo handling, logistics, systems engineering, and transportation. His work at UCLA led to the development of a general-purpose computer system for handling the complex operations of cargo handling and other systems, some of the first systems to use computer simulation as a research tool. Russ' work contributed to the modernization of cargo-handling operations and the adoption of standardized containers.

During World War II, the U.S. Navy had encountered many problems and inefficiencies in its handling of cargo. After the war, both the Navy and the commercial shipping industry were looking for better ways to handle the growing volume of cargo. An earlier attempt to introduce containers had yielded poor results. It became apparent to Russ that the entire cargo-handling operation—factory to truck to railcar to ship—should be considered as a system. His research was an important part of a national effort that led to the cargo system in use today in which standard containers are loaded at the factory and unloaded at the final destination. His work also led to the development of a general purpose computer system for handling the operations of complex cargo movement and other transportation systems.

Prior to this innovation, one of the most significant problems had been the involvement of longshoremen in offloading trucks or railcars at the dock, transferring the cargo to cargo nets and then into the holds of ships. The process was reversed on the receiving end. This backbreaking process was not only time-intensive, but was physically hard on the longshoremen. Russ' work thus not only improved cargo-handling efficiency, but also contributed to the well-being of the longshoremen

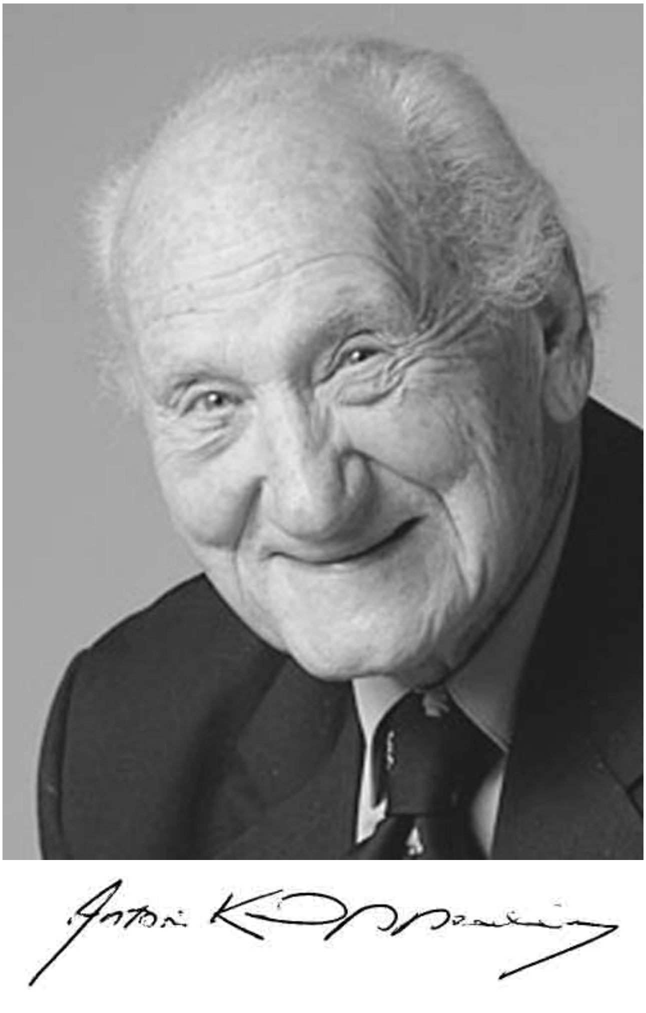
In 1974, Russ was appointed dean of the UCLA engineering school, a position he held until 1983. Prior to that, he had held several administrative posts, including assistant head of the Engineering Extension, assistant dean of graduate studies, coordinator of the Engineering Executive Program (a professional master's degree program), and assistant director of the Institute of Transportation and Traffic Engineering. He had also been acting dean on two occasions. As an administrator, Russ was known for his ability to develop consensus among diverse groups, and several of his associate deans went on to have successful administrative careers at UCLA and other institutions across the nation.

In 1977, Russ was awarded the UCLA University Service Award, which is given to alumni who have "significantly enriched UCLA and whose efforts have added depth and stature to the reputation of the university." In 1983, he was the recipient of the UCLA Engineering Alumnus of the Year Award in recognition of his "superior achievements [that] brought honor and distinction to the school." Russ retired in 1983, but he remained actively involved in teaching and in the UCLA community. He was recalled to UCLA to teach the core engineering ethics course, "Ethical and Professional Issues in Engineering and Computer Science," which he continued to teach until the fall of 2006, just a year before he died.

Russ was also active in the larger community. For example, he was a member of the Board of Trustees of West Coast University and the Board of Directors of Data-Design Laboratories for many years. And from 1993 to 1996 he taught "The Future of Space" in an Elder Hostel program, which included taking students on field trips to Edwards Air Force

Base. He was also an active board member of Stone Soup, an exemplary after-school program for children. In the professional community, he was a member of Sigma Xi, Tau Beta Pi, the American Society for Mechanical Engineers, the American Society for Engineering Education, and the American Materials Handling Society. He was also was a member of the National Research Council's Maritime Transportation Research Board and on the Board of the Institute of Nuclear Power Operation.

Dr. O'Neill is survived by his wife, Sallie; sons, Richard and John; stepchildren, Stephanie Ballard and Ross Noden; and grandchildren, Margaret O'Neill and Ryan O'Neill.



ANTONI K. OPPENHEIM

1915–2008

Elected in 1978

"For contributions to the elucidation of the gas dynamics of explosions and to the analysis of surface radiant-heat exchange."

BY ROBERT F. SAWYER

ANTONI KAZIMIERZ OPPENHEIM, an expert on combustion, explosions, and radiation-heat transfer died in his home in Kensington, California, on January 12, 2008. Known for his life-long passion for research, he opted for hospice care in his home over spending his final days in a hospital, no doubt so he could continue to work, in his bed with a laptop, on the second edition of his monograph *Dynamics of Combustion Systems* (Springer, 2006). A Professor Emeritus of mechanical engineering at the University of California, Berkeley, at the time of his death, Tony had a life and career that were formed by the turbulent history of his time.

Born in Warsaw, Poland, on August 11, 1915, Tony was home-schooled in French until the age of nine, when he began attending local schools and learning Polish. This, and his later unusual introduction to English, no doubt contributed to his charming, difficult-to-identify accent. After graduating as valedictorian of his high school in 1933, he began the study of aeronautical engineering at the Warsaw Institute of Technology. The Nazi invasion of Poland in 1939 interrupted his studies, and he fled across Europe through Romania, Greece, France, Spain, and Portugal. In June 1940, he arrived in England and joined the Polish Army in exile in Scotland, where he taught himself English.

In 1942, he took leave of the Polish Army to study at the City and Guilds College in London, where in 1945 he completed the requirements for a degree from the Warsaw Institute of Technology and earned a Ph.D. in mechanical engineering from the University of London and a Diploma from the Imperial College. During this time, he worked, under the supervision of Sir Owen Saunders, successfully researching ways to improve the performance of piston engines for RAF fighter planes, thus giving them a performance edge over German fighters.

Other work included gas-turbine combustion and the study of the combustion dynamics of the German V-1 pulse-jet engine. As a recognized authority on the V-1, he went to Germany after the war as a British intelligence officer to interview the engineers who had developed the V-1 engine. His interest in and subsequent study of detonation and combustion phenomena resulted from these early studies and experiences.

After three years as a lecturer in mechanical engineering at City and Guilds College, in 1948 Tony joined Stanford University as an assistant professor of mechanical engineering. Two years later, he moved to the University of California, Berkeley, Mechanical Engineering Department as an assistant professor; he became associate professor in 1954 and full professor in 1958.

Among his many contributions was the development and application of network analysis to the quantification of radiation-heat transfer. This analog of electrical-network analysis is still widely taught. His studies of the mechanisms of detonations included both experiments and theory. Because detonations occur so rapidly, the mechanism of their development and propagation was largely conjecture. Tony recorded the transit of detonations, first using wall tracings in detonation tubes and then photographic recordings with picosecond, laser-pulse illumination. His interest in the dynamics of explosions and reactive systems led to collaboration in the 1960s with Rem Soloukhin of the Soviet Union and Numa Manson of France to establish the International Colloquium on the Dynamics of Explosions and Reactive Systems, which will hold its 22nd biennial meeting in Minsk in 2009—a testament to Tony's vision.

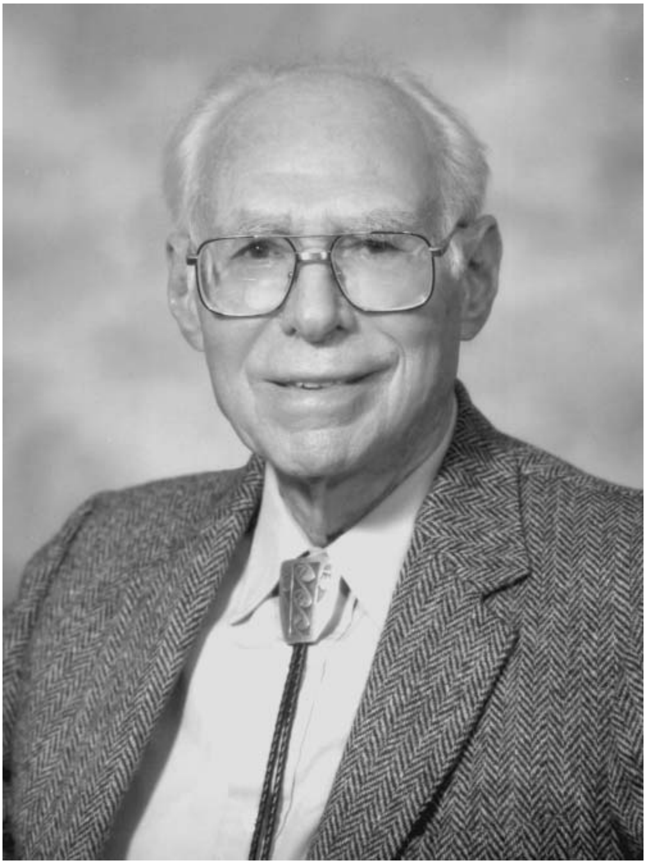
His active study of combustion phenomena, over six decades, included vector-polar methods to describe gas dynamic-front interactions, blast-wave theory, turbulent combustion, plasma-jet ignition, turbulent jet plumes, laser ignition, and distributed combustion in engines (the foundation for homogeneous-charge compression-ignition engines). Following his official retirement from the University of California, Berkeley, he focused his considerable energy and enthusiasm on developing his ideas for improving the performance of internal combustion engines.

Tony received honorary degrees from the University of Poitiers, University of London, and Warsaw University of Technology. The University of California awarded him the Berkeley Citation, its highest honor, which is bestowed on individuals who have exceeded the standards in their field. He received the Dionizy Smolenski Medal of the Polish Academy of Sciences for outstanding contributions toward advances in the knowledge of combustion and the Alfred C. Egerton Medal of the Combustion Institute for distinguished, continuing, and encouraging contributions to the field of combustion. He was a fellow of the American Society of Mechanical Engineers, a foreign member of the Polish Academy of Sciences, a fellow of the Society of Mechanical Engineers, and a member of the National Academy of Engineering.

Tony's sensitivity to the insecurity of his graduate students is captured by his words of encouragement to a self-doubting student, "You were born to a Ph.D.," he said. His ebullient spirit, still strong at the age of 92, extended to his colleagues, his students, and even to his cat, which he described as "a truly magnificent animal."

His wife remembers that "we were married for over 62 years. When he proposed to me in London in 1944 he commented that he could not promise where we would live nor what our circumstances would be, but whatever happened our life would not be boring! How true that was and how rewarding."

Tony is survived by his wife, Lavinia (Min), of Kensington, California; their daughter, Terry Ann Cort, of El Cerrito, California; and two grandchildren, Jessica DiBiase and Zachary Cort.



JOHN R. PIERCE

1910 –2002

Elected in 1965

"Leading electronics engineer and satellite communications expert."

BY EDWARD E. DAVID

JOHN PIERCE, the "father" of modern communication satellites, died in April 2002. Three of his former colleagues wrote the following: "Above all, John Pierce was a man of strict integrity. He knew the difference between speculation, wishful thinking, and factual evidence. Pretence was not his way. These principles permeated his life, his contributions to science and technology, and his person. We will not often see his kind again." [1]

John Pierce was born March 27, 1910, in Des Moines, Iowa. He attended the California Institute of Technology, where he studied electrical engineering, earning a bachelor's degree in 1933, master's degree in 1934, and doctorate in 1936. He began working as an engineer for Bell Laboratories in Murray Hill, New Jersey in 1936.

Pierce's career at Bell Telephone Laboratories lasted more than 35 years. He became director of electronics research in 1952 and research director of communications principles in 1958, and held the position of executive director, research, communication division upon his departure in 1971. His

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[1] *John Robinson Pierce 1910-2002, A Biographical Memoir* by Edward E. David, Jr., Max V. Mathews, and A. Michael Noll

devotion to Bell Labs was based on the organization's integrity and focus in developing the performance and scholarship of each individual. This principle reinforced his personal philosophy of strict ethics. He would have been distressed at the outcome of the federal lawsuit that broke up the Bell System and eventually fragmented Bell Labs, which is no longer the Goliath of research.

After retirement from Bell Labs, Pierce joined the California Institute of Technology (Cal Tech), his alma mater, where he spent the rest of his career in productive work and imaginative research, especially on computer music and sound perception. During this time, he was also chief technologist of Jet Propulsion Labs, a leader in space research in which he had a lasting interest.

In the 1980s, Pierce arrived at Stanford's Center for Computer Research in Music and Acoustics (CCRMA) to pursue his longtime interests in computer music and psychoacoustics. He held the title of visiting professor of music, emeritus, and "visited" for more than 12 years, bringing intellectual and much-needed financial support to the center.

John Pierce was the originator and developer of technologies that set the stage for the "digital revolution" and was instrumental in the development of early communications satellites, such as Echo and Telstar. But he always gave credit to Arthur C. Clarke, whose proposal preceded the concrete steps leading to the demonstration of actual satellite communications, which were performed by Pierce's colleagues at Bell Labs. Among the technological inventions and realizations in which Pierce had a hand (with Shannon and Oliver) was pulse-code modulation (PCM), which set the stage for the so-called digital revolution. Pierce originated and developed high-frequency microwave amplifiers in the form of travelling-wave tubes, reflex klystrons, and electron-multiplier tubes, which for many years were main components in electronics systems.

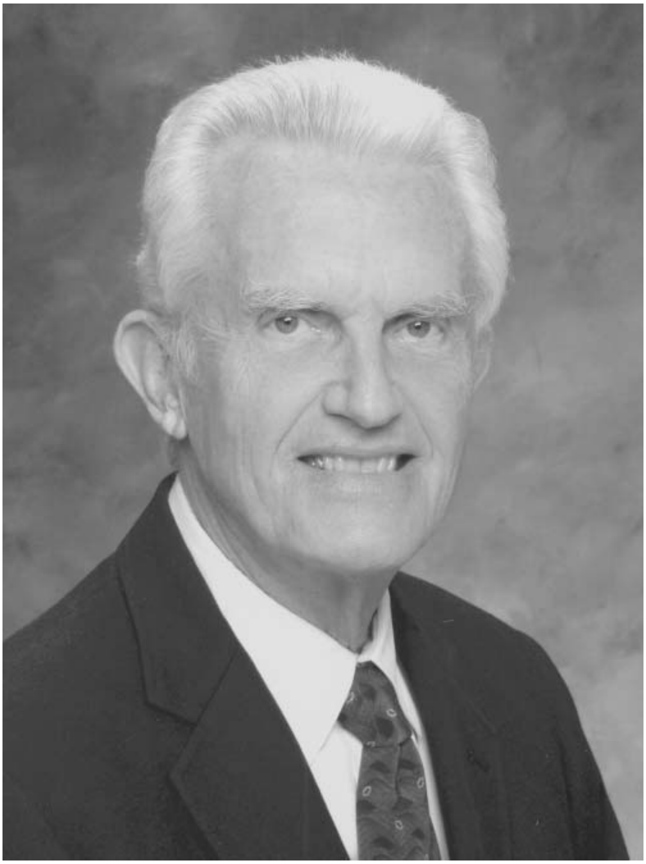
His many prizes and awards included the National Medal of Science, Japan Prize, and IEEE Medal of Honor, and he shared the prestigious Charles Stark Draper Prize with communications satellite collaborator Harold Rosen. He held 10 honorary doctoral degrees, in addition to his own "earned" one. He participated in many NAE activities, as well as studies for federal government agencies and the White House Office of Science and Technology.

But Pierce was not all business. He loved to write fiction, and he published several imaginative studies under the pseudonym J. J. Coupling (after a physics concept). He was also a musician, both performer and composer. He was involved in early computer music and concerts, including recordings for playback. John was extremely creative; for example, he coined the word “transistor” to name the first solid-state amplifier. He was also an inventor; he held more than 80 significant patents, and many of his inventions are still in use.

Less tangible, but of prime significance, Pierce had the ability to lead and inspire people, especially engineers and scientists. In 1977, he received the National Academy of Engineering Founders Award for his scholarship “in documenting the disciplines involved [in the above contributions] and authoring treatises to encourage learning and accomplishment.” He always considered himself an engineer, although he recognized that science was a necessary handmaiden.

John Pierce’s example highlights the importance of individual contributions to engineering research and innovation.

Pierce is survived by his wife Brenda Woodard-Pierce of Palo Alto; a son, John Jeremy Pierce of Bloomfield, NJ; and a daughter, Elizabeth Anne Pierce of Summit, NJ.



EBERHARDT RECHTIN

1926–2006

Elected in 1968

"For developments in missile and space technology."

BY WANDA M. AUSTIN

EBERHARDT RECHTIN was assistant director of the Jet Propulsion Laboratory (JPL); Assistant Secretary of Defense; chief engineer of Hewlett-Packard; president and chief executive officer (CEO) of The Aerospace Corporation from 1977 to 1987; professor of industrial and systems engineering, aerospace engineering, and electrical engineering systems at the University of Southern California (USC); and a principal proponent of making system "architecting" a profession. Dr. Rechtin died on April 14, 2006, at the age of 80.

The adjective "visionary," which is sometimes used to describe the careers of pathbreaking engineers, could scarcely be more applicable than in recounting Rechtin's achievements. He was a principal architect of NASA's Deep Space Network, which ultimately enabled us to communicate with distant planetary spacecraft, and his contributions to the field of systems architecture are used by engineers throughout the world. During his presidency at Aerospace, the Global Positioning System (GPS) was first activated following many years of research and development. Rechtin realized the possibility that GPS could be used for much more than its initial military and defense applications; today, GPS is used in virtually every facet of our daily lives. Above all, Rechtin was firmly committed to applying his considerable knowledge and skills to improving and maintaining the defenses and national security interests of the United States. He considered these efforts his personal contribution to securing democracy against totalitarianism.

Rechtin was born January 16, 1926, in East Orange, New Jersey, the son of a naval architect and a marine engineer. He received his B.S. (honors, 1946) and Ph.D. (cum laude, 1950) in electrical engineering from California Institute of Technology (Caltech). He served in the U.S. Navy from 1943 to 1946 and remained an officer in the Naval Reserve until 1958.

In 1948, while still working on his doctorate, Rechtin began work for the National Aeronautics and Space Administration (NASA) JPL, where he remained until 1967. His tenure at JPL coincided with the dawn of the Space Age, and his work on the Deep Space Network was complemented by his participation in other NASA projects. The Deep Space Network is a worldwide array of large-dish antennas that can track radio signals that originate millions of miles away in space. The network became operational in the early 1960s and was used to help transmit images from the Moon during the Apollo landings. Rechtin remained a lifelong advocate of space exploration, insisting that humans had reached a point in history at which they needed to be part of a system greater than anything here on Earth.

In 1967, Rechtin became the director of the U.S. Department of Defense (DOD) Advanced Research Projects Agency, which was later renamed Defense Advanced Research Projects Agency (DARPA). He subsequently held posts as principal deputy in the office of Defense Research and Engineering (1970) and assistant secretary for telecommunications (1972).

Rechtin left DOD in 1973 to become chief engineer at Hewlett-Packard, where he remained until 1977, the year he was elected president and CEO by the board of trustees of The Aerospace Corporation in El Segundo, California. Aerospace is a federally funded research and development center that operates in support of national security, civil, and commercial space programs.

During his tenure at Aerospace, Rechtin expanded the corporation's work on national security space programs and continued its existing advisory role to the U.S. Air Force on project development for a variety of defense-related space systems, such as GPS. Rechtin retired from Aerospace in 1987 and was president emeritus at the time of his death. After his retirement, he said that if he was remembered for only a single achievement during his career at Aerospace, he hoped it would be for expanding career opportunities for women and minority employees during his presidency.

That same year (1987), Rechtin was named professor of engineering at USC, where he was a tireless advocate for recognizing systems architecting as a distinct discipline; he established the first program in systems architecting within the engineering department. Rechtin retired from teaching in 1994 as professor emeritus of electrical engineering and received an honorary doctorate from USC in 2005. In 2007, the USC Viterbi School of Engineering initiated an annual Rechtin Keynote Lecture in honor of his contributions to engineering.

Rechtin was elected a member of the National Academy of Engineering (NAE) in 1968. He was also a fellow of the American Institute of Aeronautics and Astronautics (AIAA), Institute of Electrical and Electronic Engineers (IEEE), and the American Association for the Advancement of Science. He was a member of the International Academy of Astronautics, and the Institute of Environmental Sciences.

He received numerous awards and honors during his career, including the IEEE Alexander Graham Bell Medal (1977); NASA Medal for Exceptional Scientific Achievement (1965); Distinguished Public Service Medal (1973), awarded by DOD; the AIAA Robert H. Goddard Astronautics Award (1991) and Aerospace Communications Award (1969); Pioneer Award from the International Council on Systems Engineering; CalTech Distinguished Alumni Award (1984); and the Navy Distinguished Public Service Award (1983).

Rechtin's services were often sought in an advisory capacity because of his wide-ranging expertise. He was extremely proud of his membership on the U.S. Air Force Scientific Advisory Board and his service on advisory panels of the North Atlantic Treaty Organization (NATO). He also chaired the Chief of Naval Operations Industrial Advisory Committee on Telecommunications and the Naval Studies Board of the National Research Council.

Rechtin was the author or co-author of scores of scientific and engineering technical papers during his long career. His books include *Systems Architecting: Creating and Building Complex Systems* (Prentice Hall, 1990) and (with Mark Maier) *The Art of Systems Engineering* (CRC Press, 1996) and *The Systems Architecting of Organizations: Why Eagles Can't Swim* (CRC Press, 1999).

An enthusiastic supporter of the arts and an accomplished musician in his own right, Rechtin played the violin, piano, and classical guitar. He loved chamber music and had participated in chamber music groups since his college years. A great improviser on the piano, he composed many pieces for the enjoyment of his family. A complement to his musical abilities was his considerable talent as a dancer. Rechtin was also an outdoor enthusiast, conservationist, and nature lover, and he enjoyed hiking in the High Sierras of California.

Rechtin was a longtime resident of Rolling Hills Estates, California. He was a loving husband to his wife of 55 years, Deedee, and a devoted father to their five wonderful children: Mark Rechtin of San Pedro, California; Andrea Rechtin of Albany, California; Julie Rechtin of Aiden, California; Nina Meierding of Ventura, California; and Erica Bauermeister of Seattle, Washington.


Charles E Reed

CHARLES E. REED

1913–2007

Elected in 1969

"For his engineering accomplishments in blending scientific, technological, and commercial elements to the production of man-made diamonds, new silicones, commercialization of oxidative technology in the form of lexan polycarbonates and the plant design and process developments accompanying these new materials."

BY WILLIAM F. BANHOLZER

DR. CHARLES E. REED, 94, retired executive from General Electric (GE), passed away on November 16, 2007, at his home in Bridgeport, Connecticut, at the age of 94.

My first memories of Charlie Reed date back to my days as a young engineer at GE, working on my first silicon catalysis project. One day, my boss told me I was going to have an important visitor. Not long after, an older gentleman walked into my lab, but I did not recognize him. He asked a lot of questions, and he was intensely interested in everything we discussed. I remember thinking that his enthusiasm and curiosity were contagious.

I later asked a colleague who he was. The reply, "That was Dr. Charles Reed! Not only a distinguished GE leader, but also an amazing engineer." I was speechless — Charlie was "THE" engineer who had developed the fluidization process I was working on. In this first meeting it was already obvious to me that Charlie Reed was a passionate scientist — curious and humble, intuitive and inspiring. He loved his craft, and his enthusiasm was apparent in everything he did and to every life he touched.

Born in Findlay, Ohio, in 1913, Charlie graduated from Case Institute of Technology in Cleveland and later from the Massachusetts Institute of Technology (MIT) with a doctorate in chemical engineering by the age of 24. He joined GE in 1942, leaving an assistant professorship at MIT to become a research associate at the GE Research Laboratory. Now it seems such a gamble: this was a time when the company was far better known for its efforts in the electrical industry than for its embryonic chemical businesses.

Over the next three decades, Charlie helped GE become a top manufacturer of high-performance, engineered materials. He managed GE's first chemical engineering division which led to the development of the first commercial production plant for the manufacture of silicone polymer oils, rubbers, and resins. Charlie became the first general manager of GE's Silicone Products Business Department when it was organized in 1952. Six years later, he moved to the post of general manager of the Metallurgical Products Business Department, which produced cemented tungsten carbides, permanent magnets, the first Man-Made™ industrial diamonds, and Borazon® cubic boron nitride products. When the two departments were combined, GE made him general manager for the new Chemical and Metallurgical Business Division. Under his guidance, the division capitalized on the success of GE's LEXAN® polycarbonate resin.

GE elected Charlie to the position of company vice president in 1962. This was followed by six years as group executive for Components and Materials and then senior vice president on the corporate staff. Later, he was named head of the corporate technology staff and director of corporate strategic planning.

Charlie served as a member of GE's Corporate Policy Board and consultant to the chairman and CEO until he retired in 1978. He was a fellow of the American Institute of Chemical Engineers, and he held numerous patents in silicone manufacturing. Although Charlie was less directly involved in management after his retirement, he remained extremely active in many small local companies as both investor and advisor.

GE credits Charlie with more than $3 billion in annual sales from the engineering materials businesses he built and managed.

These products can be found in everything from bathtub caulk and oil-drilling equipment to football helmets and aircraft—virtually everywhere, including outer space, in the soles of the boots worn by the astronauts who first walked on the moon. Jack Welch has said that "under Charlie Reed's leadership, GE became a world leader in high-technology materials—first in the silicone industry, then in the manufacture of man-made diamonds, and ultimately in the engineering plastics industry."

We often refer to an expert by saying "he wrote the textbook on that"—but Charlie actually did. He was co-author of *Applied Mathematics in Chemical Engineering* (McGraw-Hill, 1957)—which is still considered the classic educational text in the field. And for a scientist, there is no honor greater than the National Medal of Technology. In 1991, Charlie traveled to the White House where President George H. W. Bush presented him with that award, our nation's highest technology honor.

Charlie was the kind of person who saw the future and pursued opportunities despite—or maybe because of—the limited frame of reference we have as humans. His vision and principles were so well respected that they formed a kind of creed—we called it "Reed's Creed"—and it had these tenets:

- Always look for the competitive advantage.
- Exploit it with effective teamwork among engineering, manufacturing, marketing, and finance.
- Avoid the complacency that comes with a single success.
- Look for the breakthroughs in science and technology that will help you extend your market basket.
- Make your own products obsolete before the competition does.

In all of the best ways, Charlie embodied the type of executive who leads well, seizes the future, and gives back generously to younger men and women so they can continue the rich legacy of science, technology, and engineering. After retiring from GE, Charlie was chairman of the board for the Biological Energy Corporation and a member of the boards of several other organizations, including the University of Bridgeport in Connecticut. He was a member of the National Academy of Engineering and he endowed many foundations and charitable causes during his lifetime and beyond.

Despite his promotion to the highest management levels at GE, he remained an engineer at heart throughout his life and he never lost his passion for innovation. I remember planning a meeting of senior leaders at GE. I had asked Charlie to attend the session as our guest speaker, requesting that he share how he evaluated risk and took the initiative to launch new businesses for GE. He was about 80 years old at the time and had been retired for nearly 15 years, but he began to speak and it was like we were listening to an engineer fresh out of school. He explained how he had worked in thixotropic liquids and how that had given him the idea to move into new materials. He talked for more than an hour and the time flew by as he explained his management philosophy with a little bit of history thrown in for good measure.

While I might not remember every detail of that talk, I will never forget his obvious passion for innovation and his clear explanation of the need to take prudent risks. He told the group that the decision to build the first polycarbonate plant was made before the complete process had been worked out. He knew that polycarbonate was an incredible product and that speed was essential if the company were to capture the market. As I listened, I was struck by the contrast between today's overly disciplined financial leaders, who often stifle innovation with their fear of failure, and Charlie's visionary leadership — a combination of gut level trust in the technology and financial common sense. This is something we've lost. Today there are many accomplished MBAs in the executive seat. But Charlie was more — the type of leader who could give a deep technical lecture as well as discuss the merits of risk taking in business while explaining the sensitivities in the NPV calculation. I will never forget his parting advice, "Don't let the bean counters set your strategy."

Charlie Reed was a remarkable man and without peer in his field. He brought value to his company, to his profession, to an entire industry, and to everyone who knew him. It was Leonardo da Vinci who said that "a life well spent is long." At 94, our friend undeniably had a long life. And, Charlie, you certainly spent it well.

ROBERT CLARK REID

1924–2006

Elected in 1980

"For contributions to methods of computing physical properties and the understanding of boiling heat transfer between immiscible liquids.

BY P. L. THIBAUT BRIAN

ROBERT CLARK REID, who died on May 18, 2006, in Winchester, Massachusetts, was Professor Emeritus of Chemical Engineering at Massachusetts Institute of Technology (MIT), where he spent his entire professional career. Bob was renowned in the chemical engineering community for his contributions to methods of teaching thermodynamics, estimating physical properties, and a variety of complex physical-chemical phenomena, including the phase behavior of supercritical fluids and boiling heat transfer at the interface between two immiscible liquids. An inspirational teacher and a warm and generous mentor, Bob was beloved by generations of students who studied under him during his many years at MIT.

Bob Reid was born in Denver, Colorado, on June 11, 1924. He was active in scouting, attaining the rank of Eagle Scout. After graduating from East High School in Denver in 1942, he enrolled in the Colorado School of Mines, but he left in December 1942 to enlist in the U.S. Army Air Corps. In May 1943, he was diagnosed with rheumatic fever, and the Air Corps gave him a medical discharge. He then entered the U.S. Merchant Marine Academy at Kings Point, Long Island, New York, and graduated in 1945. He served in the Merchant Service and was licensed as third assistant engineering officer in January 1946. At that time, he was also commissioned an ensign in the U.S. Naval Reserve, in which he served until his discharge in February 1952.

Bob returned to the Colorado School of Mines in 1946 and majored in petroleum engineering. In 1948 he transferred to Purdue University to study chemical engineering and was awarded a B.S. in 1949 and an M.S. in 1950. The Merchant Marine Academy also awarded him a B.S. in 1950. In 1951, he enrolled as a graduate student at MIT, where he received a Doctor of Science degree in chemical engineering in 1954.

When he joined the MIT faculty as assistant professor of chemical engineering, he was appointed director of the Oak Ridge Engineering Practice School at Oak Ridge, Tennessee. In 1956, he returned to the main MIT campus in Cambridge and was named overall director of the School of Chemical Engineering Practice, a post he held until 1963. Under his leadership, the Practice School was rejuvenated, as several of the old industrial stations were closed down and more modern ones were added. Bob was promoted to associate professor in 1958 and full professor in 1965. He was named Chevron Professor in 1981 and professor emeritus in 1985.

Professor Reid's professional interests included a variety of areas in chemical engineering. In 1958, he co-authored the legendary reference book *Properties of Gases and Liquids* with Tom Sherwood (McGraw-Hill Book Company). Over the next 40 years, three more editions were published with revised texts, and John Prausnitz, Bruce Poling, and John O'Connell were added as co-authors. In 1974, Bob and Michael Modell co-authored *Thermodynamics and Its Applications;* for 23 years, this was the textbook for the basic course taken by all MIT graduate students in chemical engineering. The 1997 revision by Jeff Tester is still the textbook for that course. Bob authored two more books, *Modeling Crystal Growth Rate from Solution* (Prentice Hall, Engelwood 1973), with Makoto Ohara, and *Creativity and Challenges in Chemical Engineering* (Board of Regents of the University of Wisconsin System, 1982).

Professor Reid supervised the research of 35 doctoral students and published about 150 papers describing important contributions to a variety of new fields, including boiling heat transfer at the interface between immiscible liquids, heat transfer with frost formation on cold surfaces, heat transfer to chemically reacting gases, kinetics of oxidation reactions, crystal growth, estimation of physical properties, extraction with supercritical fluids, liquid natural gas and liquefied petroleum gas safety, and many others.

Professor Reid was a consultant for Arthur D. Little Inc., Nestlé S.A., Cabot Corporation, E.I. du Pont de Nemours & Co., and Technology and Management Systems, Inc. Many of his research interests were based on his consulting experiences, and he brought this industry perspective into his research laboratory and his classroom. As a teacher, he was interested in each of his students and devoted to their development, both professionally and personally.

Bob Reid gave generously of his time and talent to his profession. He served on advisory committees at Princeton University, Brookhaven National Laboratory, the National Science Foundation, National Bureau of Standards, and National Academy of Sciences. He was a member of the Editorial Board of the *Journal of Chemical Engineering Data* and *Industrial and Engineering Chemistry Fundamentals.* He was a visiting professor at the University of California, Berkeley, in 1978 and the University of Wisconsin in 1980–1981. He served as a director of the American Institute of Chemical Engineers (AIChE), was a member of the Publications Committee, and was vice chairman of the Awards Committee of AIChE. As editor of AIChE Journal from 1970 to 1976, he reinforced its reputation as the leading scientific publication on chemical engineering.

Many honors were bestowed upon Professor Reid during his illustrious career. He was a Research Fellow in physics at Harvard in 1964–1965. He received the Distinguished Alumnus Award from Purdue University in 1972. He was a distinguished lecturer at du Pont, Newark College of Engineering, University of Delaware; University of Texas; University of Wisconsin; and Oklahoma State University. In 1977, he held the Chemical Engineering Lectureship of the American Society for Engineering Education. AIChE honored him with the Institute Lectureship in 1967, the Warren K. Lewis Award for Chemical Engineering Education in 1976, and the Founders Award in 1986. He was elected to the National Academy of Engineering in 1980.

In 1950, Bob Reid married Anna Marie Murphy, known to her family and friends as Nancy. The couple settled in Lexington, Massachusetts, where Nancy still lives. They had two children, a son, Donald M. Reid, and a daughter, A. Christine Reid. Donald and his wife Holly live in Chapel Hill, North Carolina, where Donald is a professor at the University of North Carolina. Christine and her husband, Donald C. Weber, live in Arlington, Virginia, where Christine works in the science office of the Arlington county school system. Bob and Nancy Reid were also blessed with four grandchildren, Otis R. Reid, Hadley W. Reid, Sarah R. Weber, and Rebecca N. Weber.

Bob enjoyed hiking, woodworking, and drawing, first still lifes and later portraits. He also liked to bake bread and cakes. In his later years, he became interested in botany and took on the task of identifying unnamed trees in Mount Auburn Cemetery, Cambridge, Massachusetts, and on the MIT campus. He was a also a Lexington Conservation Land Steward and a member of the Chemical Advisory Team for the Lexington Fire Department.

Bob Reid will be long remembered and sorely missed by his many friends and colleagues and by scores of students who benefited from his wisdom and guidance.

KENNETH J. RICHARDS

1932–2008

Elected in 2000

"For contributions in the development of advanced copper smelting technology."

BY J. BRENT HISKEY

KENNETH JULIAN RICHARDS, retired vice president of Kerr-McGee Corporation and former president of the company's Technology and Engineering Division, died on May 11, 2008, in Oklahoma City, at the age of 75. He was elected to NAE in 2000 "for contributions in the development of advanced copper smelting technology."

Following retirement from Kerr-McGee Corporation in 1994, Ken started a successful consulting business. In addition, he was assistant secretary of commerce for technology for the state of Oklahoma, for which he had extensive experience in research and technology management, process and production development, and technology transfer. Ken was known internationally for his contributions to extractive metallurgy and his pioneering efforts in advanced copper-smelting processing.

Born in Long Beach, California, on November 29, 1932, Ken graduated from Belmont High School in Los Angeles in 1950 and then attended UCLA. Subsequently, he enrolled at the University of Utah, where he graduated with a degree in chemical engineering in 1955. Between 1955 and 1959, Ken was a process engineer, first at Union Oil Company and then at Fractionation Research Incorporated. He then became a development engineer with the U. S. Intelligence Agency (USAF) working on rare-earth production and separation. In 1959, he returned to the University of Utah to pursue a doctorate in metallurgical engineering under the supervision of Professor Milton E. Wadsworth. After receiving his Ph.D. in 1962, Ken served as a captain in the U.S. Air Force at the Aerospace Research Laboratory in the Metals and Ceramic Division.

In 1967, Ken joined Kennecott Copper Corporation in Salt Lake City, Utah, as a senior scientist. In 1974, he was promoted to director of research and development, and in 1979, he became vice president of process technology. Based on his many noteworthy achievements at Kennecott, he earned a reputation as a leader in the field of non-ferrous process metallurgy. He had been instrumental in the first commercial installation of a distributed digital-control system for copper smelting and was the principal inventor of the solid matte-oxygen converting (SMOC) process, a hallmark engineering achievement that greatly advanced copper smelting and provided the impetus for the next and future generations of the process. In 1984, he moved to Oklahoma City to become president of the Technology and Engineering Division of Kerr-McGee Corporation, where he remained until his retirement in 1994.

Ken's colleagues knew him as a person who could integrate technology and business with uncommon skill, and he received many awards for his exceptional technology management skills. He was also a mentor to a great many young engineers. He was president of the Minerals, Metals and Materials Society of the American Institute of Mining, Metallurgical and Petroleum Engineers and was named to the Hall of Fame of the Oklahoma State University College of Engineering, Architecture and Technology in 1993; he was also an early contributor to the Oklahoma Center for the Advancement of Science and Technology.

Ken Richards is survived by his wife Shirlene; their three sons, Brian Richards (Fort Worth, Texas), Kevin Richards and his wife Elizabeth (Houston, Texas), and Steven Richards and his wife Tiffany (Oklahoma City, Oklahoma). He also leaves behind seven grandchildren.

JOSEPH G. RICHARDSON

1923–2007

Elected in 1988

"For pioneering studies of oil recovery by water flooding and water imbibition, and for development of broadly applicable reservoir engineering technology."

BY MICHAEL PRATS

JOSEPH G. RICHARDSON, founder of J. Richardson Consultants, Inc., a gentle man of integrity, courage, and purpose and one of the most prestigious reservoir engineers on the international scene, passed away peacefully at his home in Houston on November 18, 2007, at the age of 84.

Joe was born in Gulf, Texas, on October 28, 1923, to Jane Allsup and David Richardson. At the time, Gulf, which is on the Intracoastal Canal, was a company town operated by the Texas Gulf Sulphur Company, with a population of 1,500 at its peak *circa* 1930; the number dwindled to a few hundred inhabitants when the nearby sulphur supply was exhausted. A new company town, Newgulf, was then established some 40 miles inland, and Joe attended high school in nearby Boling.

Although Joe had his sights set on Rice University, he bowed to his father's wishes and entered Texas A&M University. However, his studies were interrupted by his induction into the U.S. Army in 1943. His army training included electronics school at both Harvard and Massachusetts Institute of Technology (MIT), radar school at Eastern Signal Corps Training Center, Fort Monmouth, New Jersey, and antiaircraft artillery school at Camp Davis, North Carolina. Joe served as a radar maintenance and repair officer, Harbor Defenses of Balboa, Canal Zone. During his service he attained the rank of first lieutenant; he received an honorable discharge in 1946. He then resumed his education, receiving a Bachelor of Science degree in chemical engineering from Texas A&M 1947 and a Master of Science degree in chemical engineering from MIT in 1948.

After graduation, Joe began his career with Humble Oil & Refining Company; he remained with the company until he retired in 1986 when the company was known as Exxon. His pioneering studies on the effect of reservoir and fluid properties and flooding rate on oil recovery led him to conclude that these factors would also have a significant impact on the engineering of water floods in large reservoirs.

By the early 1960s, Joe was an industry-recognized expert in reservoir engineering. Eventually, he was asked to manage study groups and provide advice on the relevant aspects of operating the Exxon's most important oil and gas reservoirs. In this capacity, he presented the company's position in technical and business discussions with his counterparts in competitor and national oil companies and at meetings around the world. He was especially effective at interacting with U.S. governmental agencies, competitor oil companies, and representatives of national oil companies and associated government entities. Within Exxon, he was well regarded and appreciated for his valuable advice on the technical management of major assets and his ability to interact both with domestic and international partners.

Domestically, Joe was especially valued for his sustained efforts on the Prudhoe Bay oil field—his reservoir analyses from soon after discovery (1968) to his testimony before the famous Prudhoe Bay Arbitration Panel (1983–1985), which was convened when the owners could not agree on equity involving 10 billion barrels of oil and 27 trillion cubic feet of natural gas. Joe played a very large part in the Prudhoe Bay arbitration. As chief witness for Exxon on key reservoir issues, he underwent a grueling experience, not only because of the length of the testimony but also because of the cross-examination that followed. Recognition from Exxon included the Award of Excellence as Outstanding Lecturer for the Advanced Reservoir Engineering School which he received four times (in 1973, 1975, 1977, and 1980). After 38 years, Joe retired from Exxon Production Research (EPR) Company in 1986 as senior engineering scientist, the highest position on EPR's professional ladder.

Following retirement, Joe was president of J. Richardson Consultants, Inc., and a founder and partner of Richardson, Sangree & Sneider, both Houston-based consulting companies. He was a licensed professional engineer in Texas.

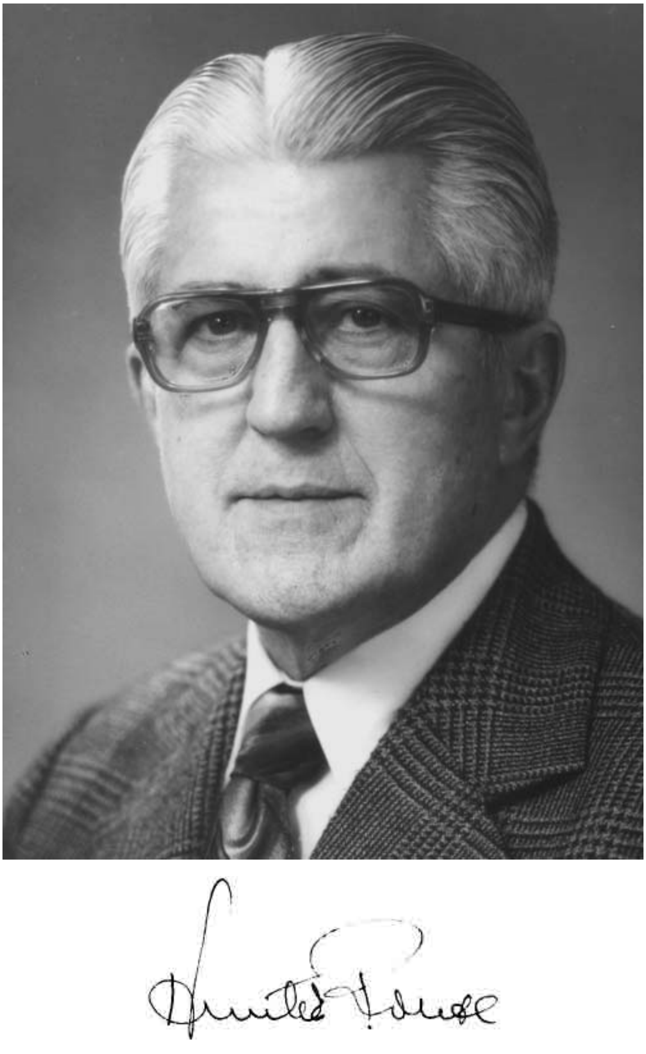
Joe was elected to the National Academy of Engineering in 1988 "for pioneering studies of oil recovery by water flooding and water imbibition, and for development of broadly applicable reservoir engineering technology." Unfortunately, by that time in his life, he was not very mobile. I remember well how he struggled up the steps to the podium with the help of his cane during the induction ceremony, his face flushed with physical effort. That event epitomizes two qualities of his character—tenacity and true grit. Joe had been partially paralyzed since 1968, long before the Prudhoe Bay arbitration, and his perseverance and determination to excel professionally and remain mobile and of good cheer was an inspiration to many.

Joe also belonged to the Society of Petroleum Engineers (SPE) and the American Petroleum Institute (API), but the SPE is the organization to which he was committed and which he loved. Before his retirement from Exxon, Joe chaired many SPE committees, most of them dealing with publications, culminating in his election as SPE's first senior technical editor (from 1976 to 1979), responsible for the peer review of papers published in the two SPE journals. His commentary columns on the contents of the *Journal of Petroleum Technology* were typical Joe—terse and to the point.

Joe also served on many other committees, chairing one on awards. He was a member of the SPE Board of Directors from 1980 to 1982. He received the Lester C. Uren Award from SPE in 1977, the DeGolyer Distinguished Service Medal in 1978, and the Legion of Honor Award in 1988. SPE named him a Distinguished Member in 1983 and an SPE Honorary Member in 1987. In 1988, he was named an Honorary Member of The American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME).

In my estimation, Joe's most far-reaching and significant publications were "Differences in Behavior of Fresh and Aged East Texas Woodbine Cores" (1955), "A Laboratory Investigation of the Effect of Rate on Recovery of Oil by Water Flooding" (1957), and "Theory and Application of Imbibition Phenomena in Recovery of Oil" (1959), all published by SPE. These three papers laid the foundation for understanding how oil recovery from water floods in large reservoirs is impacted by interactions of reservoir and fluid properties and flooding rate. These early, related publications established Joe as a world-class expert in reservoir engineering.

Joe is survived by his wife of 36 years, Patricia Richardson, sons Joseph G. Richardson, Jr., Jonathan R. Richardson, Joel G. Richardson, daughter Janet G. Richardson, and brothers William H. Richardson and Charles W. Richardson (wife JoAnn).



HUNTER ROUSE

1906–1996

Elected in 1966

"For hydraulics and fluid mechanics."

BY CORNELIA F. MUTEL AND ROBERT ETTEMA
SUBMITTED BY THE NAE HOME SECRETARY

PROFESSOR HUNTER ROUSE, long-term director of the Iowa Institute of Hydraulic Research (now IIHR-Hydroscience & Engineering) at the University of Iowa and subsequently dean of that institution's College of Engineering, died on October 16, 1996, in Sun City, Arizona, at the age of 90.

Born in Toledo, Ohio, on March 29, 1906, Rouse studied civil engineering at the Massachusetts Institute of Technology (MIT), where he received his undergraduate degree in 1929. He then spent two years as an MIT traveling fellow visiting hydraulics laboratories in Germany, where he met Dorothee Hüsmert, who was to become his wife of more than 60 years and the mother of their three children. Rouse received an M.S. in civil engineering from MIT in 1932 and a doctoral degree in civil engineering hydraulics from the Technical University at Karlsruhe the same year. Later, in 1959, he received a doctorate in fluid mechanics from the Sorbonne, University of Paris.

While in Karlesruhe, Rouse became familiar with Theodor Rehbock's River Hydraulics Laboratory and with other newly established laboratories in Germany working on hydraulics and fluid mechanics. He quickly recognized the importance of laboratory experiments and recent developments in understanding the fluid mechanics of turbulent flow, for advancing engineering hydraulics — that is, the mechanics of water flow processes. This recognition became the focus of his career.

In 1932, Rouse returned to MIT as an instructor and conducted research on weirs and spillways. He subsequently taught courses on hydraulics as an instructor at Columbia University in New York and then became an assistant professor in fluid mechanics at California Institute of Technology in Pasadena. At Caltech, he also conducted research at the Soil Conservation Service Sedimentation Laboratory. He came to IIHR as a professor of fluid mechanics in 1939 and was appointed director in 1944. In 1966, he was appointed dean of engineering, but he returned to a research position at IIHR in 1972.

Hunter Rouse's primary contribution was the application of fluid-mechanics theory, illuminated and validated by laboratory experimentation, to hydraulics. His hydraulics work put hydraulic engineering on a more rational plane than it had previously occupied.

Rouse championed the application of fluid mechanics to hydraulic engineering in many ways. He authored the first American textbook explaining hydraulics in terms of the principles of fluid mechanics, and he initiated and taught classes on the subject at the University of Iowa. He also established teaching laboratories, for which he designed some of the equipment himself.

He insisted that IIHR put great emphasis on theoretical research, and his own research provided early insights into general principles of hydraulics, especially the importance of turbulence. Under Rouse's leadership, IIHR became the preeminent U.S. center for hydraulics research and education, and the name Hunter Rouse became synonymous with excellence in fluids-engineering research, education, and application. Hunter Rouse was both energetic and driven. He insisted on high standards for his students, as well as for his own work. He organized several landmark conferences on hydraulics. A world traveler, he also organized highly regarded exchange programs and tirelessly promoted international goodwill and cooperation among hydraulics research organizations.

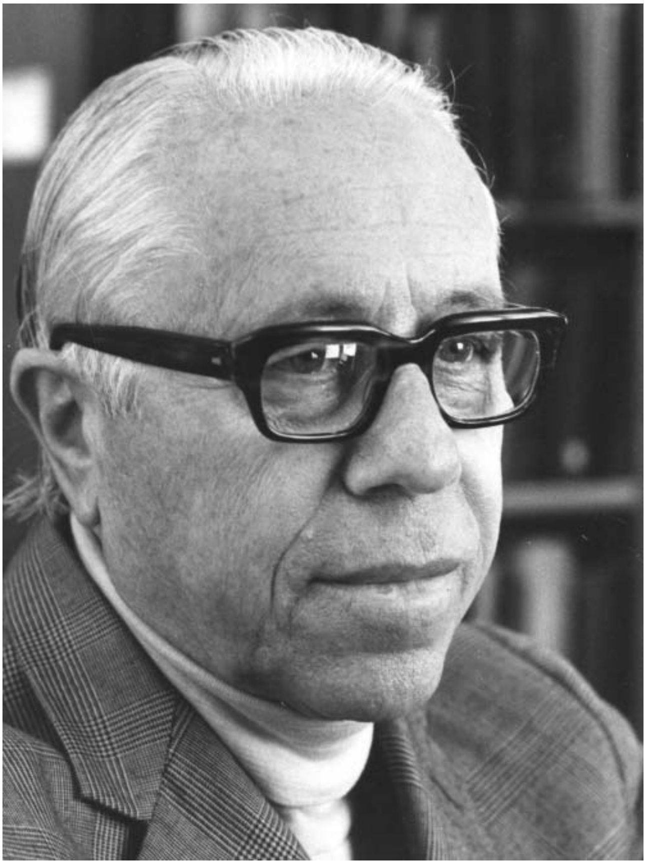
A leading authority on the history of hydraulics, he wrote two books and established a renowned rare book collection on the subject. In all, he authored or edited seven books, including a highly praised set of textbooks, wrote more than 130 technical papers, supervised more than 80 graduate students (many of whom became leading figures in the field), and produced a set of six instructional films on fluid mechanics and hydraulics. These films and some of his books are still in use.

Rouse was elected to the National Academy of Engineering in 1966. In addition, he was a fellow of the American Academy of Arts and Science (1958) and an honorary member of the American Society of Mechanical Engineers (1967), American Society of Civil Engineers (ASCE) (1973), and International Association for Hydraulic Research (1985). He was a Fulbright Research Scholar (1952–1953), and, in 1963, the recipient of the ASCE Theodore von Kármán Medal. In 1975, he was awarded an honorary doctorate by the University of Karlsruhe, given, in part, for his "pioneering achievements in fundamental research and instruction in theoretical hydraulics." In 1979, ASCE established an annual lectureship in his name, and, in 1980, presented him with the ASCE History and Heritage Award.

In 1991, Hunter Rouse received the American Association of Engineering Societies' highly prestigious John Fritz Medal, "for pioneering the application of fluid mechanics to hydraulics, fusing theory and experimental techniques to form the basis for modern engineering hydraulics." This commendation summarized both his hopes and his achievements. He also received many additional awards for his research publications and educational accomplishments.

After his retirement from the University of Iowa in 1976, he moved to Arizona, but he continued to teach summer courses in hydraulics at Colorado State University, and occasionally lectured at Arizona State University, until he was 82. He also became an amateur lapidary hobbyest, and, characteristically, he not only polished stones, but also published articles on the subject. He also continued to publish articles on the history of hydraulics. Thus, to the end of his life, he never lost his intellectual curiosity or lowered the high standards he had always embodied.

His is survived by his widow, Dorothee Rouse; two sons, Richard H. Rouse and his wife, Mary, and Allan H. Rouse; a daughter, Patricia M. Heubner, and her husband, Glenn; and six grandchildren.



Mario G. Salvadori

MARIO G. SALVADORI

1907–1997

Elected in 1983

"For innovative contributions to the design and analysis of shell and high-rise structures and methods of numerical analysis in engineering."

BY MATTHYS P. LEVY

MARIO SALVADORI, an inspired teacher, writer, and consultant, and the developer of a motivational, hands-on approach to teaching young people the rudiments of how structures work, died on June 25, 1997.

When Mario was born, in Rome on March 19, 1907, the doctor warned his parents that, because of his low birth weight, the baby might not survive. Ninety years later, marshalling his indomitable spirit, Mario was still teaching and writing. Reared in Genoa and Spain, he had hoped to become an orchestra conductor, and when he was 18, he established Italy's first jazz band. His father, who was an engineer, dissuaded the young man from pursuing a musical career. Instead, he earned two doctorates, one in mathematics and one in engineering.

Always ready for adventure, Mario was an avid mountain climber. He was known in the mountaineering press as the "Lion of the Mountain" for opening 27 new routes in the Dolomites, barely surviving a serious fall in the process. Part of the challenge for Mario was defying his father who often forbade him to climb, but who, in the end, was justly proud of his son. When Mario was in his eighties, he and I had to visit the sculptor Alexander Lieberman to look at a recent work being assembled in central Connecticut. I offered to fly to Connecticut myself and meet Mario, then fly him home to an airport close to his weekend house. It was a warm day, and the air was not very stable. After we took off, Mario reminded me not to fly too high where the air was very thin, because it would not be good for his heart. That meant we had to fly in constant turbulence for the short 45 minutes we were in the air. Although we were jostled about, Mario was a good sport, and we landed safely—only on the second try, however, because I was a little nervous about ferrying my illustrious passenger. When Mario alighted, he breathed a sigh of relief. He was somewhat green but glad to be alive.

Following his graduation from the University of Rome with doctorates in both civil engineering and pure mathematics, Mario spent a year in London studying photoelasticity. During that time, he came into contact with a number of refugees from Nazi Germany and came to realize that Mussolini's fascism was not far behind Hitler's and that it would be wise to leave Italy. Thanks to the intervention of Enrico Fermi, the Salvadori family—Mario and his first wife Giuseppina—was able to immigrate to the United States.

After working in a number of temporary jobs, including production-efficiency engineer for the Lionel Train Company, Mario was offered a substitute position at Columbia University in mechanical engineering. This soon became a permanent position in civil engineering when the war reduced the number of available instructors. Mario proved to be an inspired teacher and remained at Columbia for 50 years; he was named "best teacher" in 1962 and was honored with other prestigious awards. His students never forgot Mario's enthusiastic, clear presentations. Now scattered around the world, they remain his greatest advocates and legacy.

Mario developed a lecture curriculum in architectural structures, which he taught at Princeton University from 1954 to 1959 and then in the School of Architecture at Columbia. In 1965, when the School of Architecture was in disarray, Mario stepped in and started a program in architectural technology. He introduced new courses describing structural principles in qualitative terms without resorting to mathematics. The courses were supplemented with six films showing experiments and demonstrations that illustrated those principles. The "Structure in Architecture" program was a big hit and became the centerpiece of a popular new way to introduce the concepts of structure to non-engineers. The program was also the basis for a book with the same title.

In 1943, while at Columbia, Mario was asked to participate in a classified project, which, he learned later, was the Manhattan Project to develop a nuclear bomb. Mario's participation was purely technical and dealt with only one of the components of the ancillary structures, not with the bomb itself. It did, however, present him with a conundrum, because, although he supported the defeat of fascism, he was basically a pacifist. In the 1960s, however, he had no conflict, when during the Vietnam War and in support of his moral convictions, he actively participated in protests against the war and in support of nuclear disarmament.

In 1955, when he met and later joined with Paul Weidlinger to establish one of the leading consulting engineering firms in the country, Mario entered a new phase of his multicareered life. Several of his former students joined him as the firm grew. At first, Mario specialized in the design of concrete thin-shell structures and structures that could survive a nuclear attack. The scope of the consulting work soon included forensic engineering and the design of major structures. Mario continued as a principal in the firm until his retirement in 1992.

While he was still at Columbia, and for the rest of his career, Mario was involved in forensic investigations that often led to his testifying as an expert in court cases. He found forensic work to be both challenging and an opportunity to extend his natural ability as a teacher to the court room. A natural showman, he loved to spar with attorneys who tried to trip him up and often cited Newton as justification for an opinion. In one case, early in his career, he was asked to evaluate whether an individual had committed suicide by jumping out of a high-rise window or whether he had fallen accidentally. By invoking the laws of physics, Mario demonstrated the difference between a free fall with only vertical velocity and a jump that involved horizontal velocity as well. Based on where the body landed, he proved that the fall was accidental and earned the gratitude of the widow who was able to collect on her husband's insurance policy. That case became a landmark that has been cited in similar situations.

A supremely ethical person, Mario was always careful to inform potential forensic clients that he was only concerned with the truth, even if it were to damage the client's case. In such situations, however, Mario recused himself rather than cause his client embarrassment.

In the late 1950s, there were changes in Mario's personal life. He divorced his first wife and married Carol Kazin, becoming a father to her son, Michael, as well as his own son, Vieri. A perpetual humanist, Mario was not only a pianist with modest talent but also a translator into Italian of his beloved Emily Dickinson. He also lent his special insight into Joyce's Ulysses by lecturing students and colleagues or anyone who would listen, of the importance of this work and its significance as literature and a reflection of the times (upon his death, Umberto Eco eulogized him as a poet as well as an engineer). Mario's ability to present ideas clearly in the classroom was translated to paper when he started the first of his 15 books, five on mathematics and 10 on structures. The last books were written specifically for a lay audience, especially young people with whom Mario had developed a special bond. I was privileged to co-author five of his books, including *Why Buildings Fall Down* (W.W. Norton & Co., 1994), which remains popular to this day.

Of his many honors, Mario often said, if you live long enough, you will be rewarded, because they, that is various institutions, will run out of other people to honor. He received, of course, many honors from many institutions, including the Pupin Medal for outstanding service to the nation from the Columbia Engineering School Alumni Association in 1991, the Topaz Medallion from the American Institute of Architects in 1993, and the Founders Award from NAE in 1997 "for accomplishments that benefited the people of the United States."

In 1976, Mario began teaching a course on "Why Buildings Stand Up" to junior high school children in East Harlem. This started him on a new career to motivate young people to appreciate mathematics and physics through a hands-on understanding of the built environment. He was tremendously successful at explaining complex structural concepts using real-world examples of how bridges and skyscrapers are built. Eventually, his methodology was formalized into a curriculum, and Mario taught teachers and developed a manual outlining his approach. Today, the Salvadori Center, a non-profit organization, continues to promote and expand the methodology Mario pioneered. The "kids" became his passion, and Mario continued teaching them to the end. Had he not died on June 25, 1997, he would certainly still be using his bag of toys to teach his "kids" whom he loved and who loved him in return.

WOLFGANG SCHMIDT

1942–2007

Elected in 2001

"For outstanding contributions to computational aerodynamics and air vehicle design and engineering, and for promoting international leadership and cooperation."

BY EARLL MURMAN AND ANTONY JAMESON

DR. WOLFGANG SCHMIDT was elected a Foreign Associate of the National Academy of Engineering in 2001 for "outstanding contributions to computational aerodynamics and air vehicle design and engineering, and for promoting international leadership and cooperation." He collapsed in his wife's arms on November 2, 2007, while dancing after dinner at a favorite Austrian hotel. His death was officially confirmed shortly after midnight. Wolfgang's contributions to aerospace engineering, his talent for bringing people together, and his ability to bring out the best in everyone will have a lasting impact on the aerospace profession.

Born on February 8, 1942, in Duisburg, Germany, Wolfgang lived with his mother in the small village of Pfalzfeld until his father returned from captivity during World War II. He attended school in Pfalzfeld and the gymnasium in Duisburg before enrolling at the Technical University in Aachen. An expert swimmer and water polo player, he also enjoyed hiking and climbing in the mountains.

Upon receiving his Diploma of Aeronautics and Astronautics in 1966, he was employed as an aerodynamics engineer at Dornier GmbH in Friedrichshafen. Mr. Max, the head of the aerodynamic and flight dynamic department, asked his assistant Fräulein Weißenberger to meet Wolfgang at the main gate as he reported to Dornier, and two weeks later he and Ingrid Weißenberger had their first dance. They were married on May 29, 1971, in Immenstaad at the Hersberg Monastery on the shore of the Bodensee.

Wolfgang continued working at Dornier and its successors until his retirement, and Friedrichshafen was the couple's home for all but 10 years during which they lived in Munich. Wolfgang and Ingrid had two daughters, Maren and Anika, and two grandchildren. While Wolfgang pursued his interests in aerospace engineering, Ingrid pursued her artistic talents as a painter. Together they enjoyed time at their mountain cottage in Austria.

For the first four years at Dornier, Wolfgang was involved in the aeronautical design of wings and control surfaces for vertical take-off and landing (VTOL) and supersonic aircraft and missiles. Simultaneously, he pursued his doctoral studies in aeronautical engineering at the Technical University of Aachen, where he received his doctorate in 1972. As head of the Fluid Mechanics Group from 1970 to 1974, he also worked on the design of gas centrifuges for uranium enrichment, which led to a patent for gas bearings.

By 1974, Wolfgang had transitioned to the development and application of computational fluid dynamics (CFD) methods for compressible flow. In recognition of his management and leadership abilities, Dornier promoted him to chief of the Computational Fluid Dynamics Department. Starting with linear-panel and then transonic small-disturbance-potential methods, Wolfgang was a major contributor to the rapid development of compressible CFD methods for full-potential, Euler, and then Navier-Stokes equations for three-dimensional aircraft configurations.

During this fertile period of his career, Wolfgang established international partnerships with leading CFD innovators, putting Dornier in the forefront of CFD development and application. Collaboration with Antony Jameson at Princeton University and Eli Turkel of Tel Aviv University led to the classic AIAA Paper 81-1269, "Numerical Solutions of the Euler Equations by Finite Volume Methods Using Runge-Kutta Time-Stepping

Schemes," which was presented at the 14th Fluid and Plasma Dynamics Conference in Palo Alto, California, in 1981. This paper became the "knee in the curve" of CFD development for aircraft design, and the field was forever transformed. Dr. Paul Rubbert, Wolfgang's counterpart at Boeing Commercial Aircraft, described his colleague's work: "During those formative years for CFD, I found that Wolfgang was always at the technology leading edge as the challenges changed from linear potential flow to boundary layer methods to nonlinear potential flow, Euler Equations, and Navier-Stokes. Time and time again I found that he had turned a corner and established a new direction at the same time as I and my group did likewise. It was almost 'spooky.' In my eyes Wolfgang was clearly and continuously ahead of any other CFD research organization in Europe."

Wolfgang's accomplishments and abilities did not go unnoticed, and in 1982 he was promoted to director of Dornier's Aerodynamics Department and then in 1987 to vice president for the Dornier 328 Airplane Program, a turboprop regional aircraft with a supercritical wing. In this position, his responsibilities included marketing and sales, design and development, and manufacturing.

In 1990, with the merger of Dornier and MBB, he was elevated to director, Air Vehicle Engineering Unit, Military Aircraft Division of MBB/DASA in Munich, where his responsibilities included all configuration engineering for the F-104, Tornado, Eurofighter, JPATS Ranger 2000, Airbus components, and the Saenger and HERMES space-transport concepts. His links to the international community multiplied as he worked with his counterparts in the United States, United Kingdom, France, Indonesia, and Russia.

Following additional consolidation in the German aircraft industry, Wolfgang was appointed vice president of technology, strategy, and innovation for Daimler Benz AG in Stuttgart in 1995. From then until his retirement from Daimler Chrysler AG in 2004, he concentrated on corporate technical strategy and built important partnerships with industries and universities in Europe, the United States, Russia, Israel, and Japan.

After retirement, Wolfgang enjoyed an affiliation with the Aerospace Department at the Technical University of Munich, where he was deputy head of the aeronautical section. With great enthusiasm, he taught two courses, supervised several master's students, and led outreach activities to research foundations and other universities. Wolfgang was also a consultant to aerospace companies and a contributor to professional societies until his untimely death.

Wolfgang's international reach went well beyond the confines of his employers. He was active in major professional societies and coordinating bodies. As an NAE foreign associate, he participated regularly in U.S. meetings and arranged a very successful European regional meeting of foreign associates. Perhaps his most important contributions were to the International Council of Aeronautical Sciences (ICAS). In 1995, he became a member of the Programme Committee, and from 1998 to 2000 he was committee chair; from 2000 to 2002 he was ICAS president, and from 2002 to 2004, he was ICAS past president. Wolfgang was also active in the American Institute of Aeronautics and Astronautics (AIAA), for which he served on numerous technical and other committees, particularly as executive chair of the AIAA/ICAS International Air and Space Symposium in 2003, which marked the 100th anniversary of powered flight. He was elected a Fellow and then Honorary Fellow of the AIAA and a Fellow of the Royal Aeronautical Society. He also was a member of many international coordinating groups, including AGARD (1985–1991), DGLR (2000–2008), SAE World Aviation Congress, and the European GARTEUR (1978–1987).

Wolfgang authored or co-authored more than 100 technical publications, was awarded five patents, taught four AIAA professional study seminars, gave numerous talks, and frequently chaired sessions at technical meetings. Thanks largely to his leadership and technical contributions, Dornier's Aerodynamics Group achieved world-class status.

Beyond his professional accomplishments, Wolfgang was a colleague and a connecting link between people, from students to executives. His infectious enthusiasm, perceptiveness, and gracious behavior were magnetic. Everyone looked forward to seeing him and spending time with him, whether it involved a technical exchange, a strategy session, or a social activity. He will be sorely missed, but not forgotten by all of his international colleagues.

Alexander C. Scordelis

ALEXANDER C. SCORDELIS

1923–2007

Elected in 1978

"For pioneering the development and application of advanced structural analysis to the design of record-breaking and unique structural systems."

BY JOHN E. BREEN

ALEXANDER C. SCORDELIS, Byron L. and Elvira E. Nishkian Professor Emeritus of Structural Engineering at the University of California, Berkeley, and one of the nation's most influential experts on design and analysis of thin-shell structures and long-span, prestressed-concrete bridges, died on August 27, 2007, at the age of 83. He was elected a member of NAE in 1978 for "pioneering the development and applications of advanced structural analysis to the design of record-breaking and unique structural systems."

Although Alex was first and foremost a renowned teacher at Berkeley, his clear, comprehensive papers and reports extended his influence far beyond the Berkeley campus. His superbly organized lectures, clear explanations, and penetrating questions led his students in the classroom and researchers in the laboratory to a deep understanding and mastery of the material. Through publications, consulting activities, and public service, he extended these benefits to consulting engineers, national and international committees, commissions charged with assessing the safety of huge, complex structures, and fellow experts struggling to understand the behavior and dynamic loading of newly emerging structural systems of prestressed concrete and thin concrete shells.

Alex was born on September 27, 1923, in San Francisco. His parents, Greek immigrants who owned a grocery store in the Marina district, instilled in him a lifelong pride in his Greek heritage. At 16, he entered UC Berkeley as an undergraduate. After Pearl Harbor, he joined ROTC and then interrupted his studies to serve in Europe during World War II with the U.S. Army Corps of Engineers. His leadership skills were developed under fire at an early age, when he fought in the Battle of the Bulge and was with the troops that liberated concentration camps at the close of European hostilities. He was awarded the Bronze Star for meritorious achievement and the Purple Heart for combat wounds. In 1946, he left active duty as a captain but continued to serve in the reserves. He ultimately achieved the rank of major.

After the war, Alex returned to Berkeley where he completed his B.S. in civil engineering in 1948, and went on to MIT where he received an M.S. in civil engineering in 1949. He then returned to UC Berkeley as an instructor and was promoted through the professorial ranks to full professor in 1962. He was awarded the Nishkian Chair as professor of structural engineering in 1987.

In the years immediately following World War II, there were three major developments in structural engineering that greatly influenced his career. The first of these was the great expansion of graduate education in engineering in the United States, which created a ready market for Alex's skills as a leader, lecturer, and innovative researcher. The civil engineering faculty at Berkeley, led by Alex and others, became one of the foremost creative teams in the world advancing structural mechanics and structural engineering.

The second development was the emergence of an essentially new material, prestressed concrete, as the dominant construction material in medium- and long-span bridges. Alex was an organizer of the First World Conference on Prestressed Concrete in 1957. Led by T. Y. Lin, his Berkeley colleague and lifelong friend, this conference was the practical introduction in the United States of a unique form of construction that had been recently introduced more widely in Europe for the reconstruction of major bridges that had been damaged or destroyed during the war. Alex's advanced analysis techniques became the most widely used procedures for analyzing reinforced and post-tensioned concrete box-girder bridges, an efficient and attractive structural art form that soon appeared in California and across the country. He worked closely with Lin to provide an analytical framework for many of Lin's pioneering designs.

The third development was the birth of the electronic computer and the mushrooming growth of numerical analysis and computation procedures in structural engineering. The Berkeley group, with leaders like Ray Clough, Ed Wilson, Karl Pister, Vitelmo Bertero, Boris Bresler, T. Y. Lin, Egor Popov, and others, combined efficient numerical analysis tools and advanced understanding of both structural analysis and structural behavior to launch comprehensive new analysis and design procedures for structural engineering. Alex, who had great insight into structural behavior based on more classical analyses, brought this insight to the new computer analyses to develop revolutionary analysis procedures for long-span, box-girder bridges and free-form, thin-shell structures. He enabled designers to analyze and design graceful, slender bridges and inspirational thin-shell roofs. Using models of box-girder bridges, he verified the accuracy of the analyses in laboratory tests.

In recognition of his accomplishments, Alex received three American Society of Civil Engineers (ASCE) Moisseiff Awards for papers in 1976, 1981, and 1992. This award is given for excellence in papers on structural design, including applied mechanics, theoretical analysis, or constructive improvement of engineering structures. Alex was cited for nonlinear analysis of reinforced-concrete shells, the analysis of curved, prestressed, segmental bridges, and the analysis of slender, concrete bridge towers under cyclic lateral load, all of which were not only complex analytically but were also important to practical design and public safety. These were the overriding common denominators of Alex's work—intellectually advanced and rigorous analysis for important engineering applications.

The engineering profession recognized his accomplishments by naming him an Honorary Member of ASCE in 1989 and an Honorary Member of the International Association for Shell and Spatial Structures in 1992 and bestowing on him ASCE's Howard Award for structural design in 1989. In 1994, the International Federation for Structural Concrete awarded him its highest honor, the Freyssinet Medal, only the third time an American was so honored. He was the author of more than 170 papers and also served on a number of governmental boards assessing seismic safety — including panels on the Golden Gate Bridge and the design of a new eastern span for the San Francisco-Oakland Bay Bridge. He was one of 11 members appointed by the governor of California in 1989 to a Board of Inquiry into the Loma Prieta Earthquake, to issue the defining assessment of the quake's impact on California's infrastructure. Throughout his career, Alex Scordelis was a consultant on applications of his physical and computational research to practical engineering projects, including more than 40 major projects, such as thin-shell structures and long-span bridge structures.

However, simply recounting Alex's technical accomplishments does not convey the essence of his greatness. Alex was vitally interested in the development of engineers as people. He challenged his students in the classroom with penetrating questions to stimulate their understanding, encourage them to apply the techniques they had learned to a wide range of problems, and help them learn to express themselves effectively.

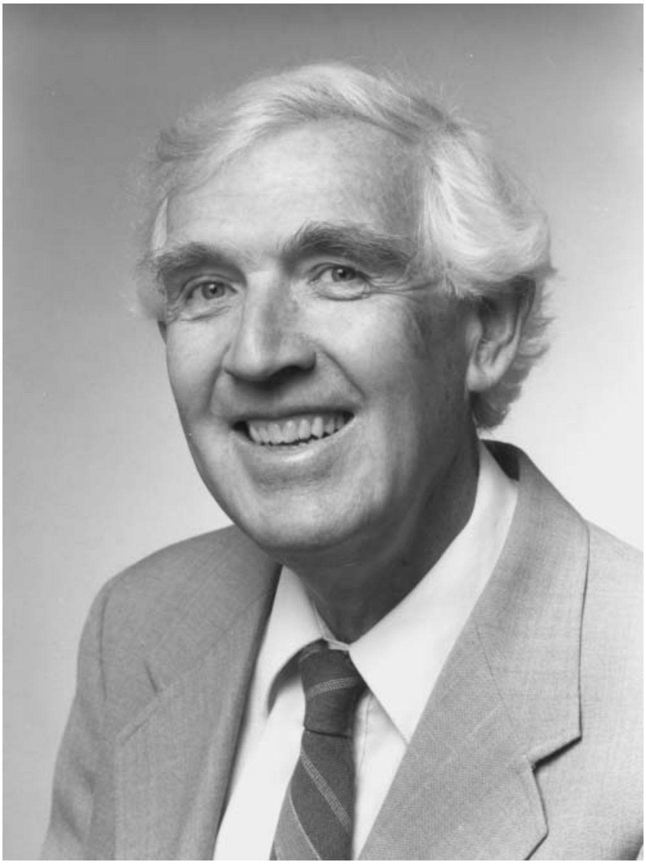
A treasured member of professional committees, Alex had the ability to clarify competing and conflicting points of view and develop consensus on important design and analysis procedures. Particularly in the area of thin-shell structures, he had to deal with strong-willed experts with fiery artistic temperaments. Somehow, Alex was able to "herd cats" and move even these groups toward consensus.

He had a special gift for relating to young people — his children, his students, his research students, young faculty, neophyte experts serving on their first national or international technical committees, young designers in consulting offices or bridge departments. He never talked down to them, and he always took a personal interest in their work. He had a wonderful sense of humor, often self-deprecating, and a knack for reducing complex subjects to their essence, showing relationships between topics, and presenting the results in the form of targeted questions that ensured his pupils or listeners really understood the solution.

He could be as dedicated in teaching the proper appreciation of a glass of ouzo as he was in explaining how to set up a proper finite-element analysis of a curved post-tensioned bridge. He was just as willing to teach important life lessons—how to make an effective presentation, or win engineers over to your point of view, or achieve consensus on a report assessing the structural safety of a complex structure — as he was to teach technical solutions.

With his passing, many of us recall his pivotal role in the development of our engineering judgment and, more important, in the development of our engineering character. Alex Scordelis left behind a legion of former graduate students who have extended his research ideas in myriad ways. At his memorial service, one of these students said that he wished "to recognize and applaud this thought-provoking mentor and educator who motivated many of us to follow in his footsteps." Socrates would approve.

Just as Alex Scordelis influenced generations of engineering students, he leaves a legacy of wisdom, values, and love for generations of his family. He is survived by his wife of 59 years Georgia, son and daughter-in-law Byron and Stephanie Scordelis, daughter and son-in-law Karen and Robert Holtermann, and four grandchildren.



Ronald F. Scott

RONALD FRASER SCOTT

1929–2005

Elected in 1974

"For contributions to the theory and application of soil mechanics."

BY PAUL C. JENNINGS AND PAMELA J. SCOTT

RONALD FRASER SCOTT, Dotty and Dick Hayman Professor of Engineering, Emeritus, at the California Institute of Technology in Pasadena died on August 16, 2005, at the age of 76. He was elected to the National Academy of Engineering in 1974 for "contributions to the theory and application of soil mechanics."

An internationally recognized expert on the mechanics of soils, Ron worked on a wide range of problems, including the freezing and thawing of soils, the characteristics of lunar and Martian soils, the characteristics of ocean-bottom soils, soil liquefaction, the dynamics of landslides, and the mechanism of earthquake-caused sand blows. He pioneered the use of centrifuges in the United States for studying the behavior of soil structures, such as earthen dams, under both static and dynamic loading.

Ron was born in London, but grew up in Perth, Scotland, where, among other things, he dug potatoes during World War II when the men were all in the service. He earned a bachelor's degree in civil engineering from the University of Glasgow in 1951 and then came to the United States where he earned an Sc.D. in civil engineering (soil mechanics) from the Massachusetts Institute of Technology in 1955. After graduation, he worked for the U.S. Army Corps of Engineers on the construction of pavements on permafrost in Greenland and for the engineering consulting firm of Racey, McCallum and Associates of Toronto.

Ron met his wife, Pamela Wilkinson, a flight attendant for American Airlines from Bedfordshire, England, on his way to Caltech for an interview. They were married on May 28, 1959, and subsequently had three sons, Ron and twins Craig and Grant, and then nine grandchildren. Ron rose through the academic ranks at Caltech to full professor in 1967 and became Hayman Professor in 1987. In 1998, he became professor emeritus.

Ron had a deep understanding of theoretical aspects of the mechanics of solids, and his research was characterized by thorough study of underlying scientific issues. He was always motivated, however, by practical problems and was adept at showing how his research results could be useful in engineering practice. He also had a knack for explaining complicated concepts in soil mechanics to the general public.

In the 1960s, Ron became involved in evaluating the properties of lunar soil to determine if manned spacecraft could land safely on the lunar surface. At the time, there was wide speculation; some thought the Moon was covered with a thick layer of fine powder that would not support a landing vehicle or a man on the surface; others believed that the surface was quite firm. In 1963, Ron proposed that NASA include an experiment on soil mechanics on a Surveyor spacecraft. The proposal was accepted, and Ron became the principal investigator.

The experiment was first flown in 1967 on Surveyor III. The surface sampler, as it was called, resembled a small backhoe shovel mounted on an extensible trellis. After the successful landing, Ron wrote that "for the next two weeks, Floyd [JPL engineer Floyd Roberson] and I happily and sleeplessly played with the lunar soil on the inside surface of a 650-foot diameter crater."

Many readers will remember the pictures of the "scoop" digging into the lunar soil relayed from the Moon. Although it looked like a toy, the scoop was, in fact, an ingeniously designed instrument that made significant measurements of the strength, cohesion, and density of lunar soil. It also provided information about the homogeneity of the soil and variations in soil properties with depth. Because the sampler could exert pressure when the scoop door was closed, it was possible to use it to distinguish between rocks and clods.

From these tests, Ron concluded that the lunar soil at the site was fine-grained, with a small amount of cohesion, an internal angle of friction of 35 degrees—properties similar to those of damp terrestrial sand—and that it was safe to walk on. When Neil Armstrong stepped onto the surface of the Moon, his famous words, "That's one small step for a man, one giant leap for mankind," were followed by "I sink in about an eighth of an inch. I've left a footprint on the surface," words that confirmed Ron's conclusions.

This story has a postscript. In November 1969, Apollo 12 landed close to Surveyor III, and part of the mission of astronauts Conrad and Bean was to retrieve various parts of the Surveyor spacecraft. Although it had not been included in the plans, Conrad also retrieved the scoop and brought it back to earth. Upon learning this, Ron remarked, "If I had known I was going to see it again, I would have left the scoop completely packed with lunar soil." A similar scoop, also designed by Ron, was used on the Viking spacecraft in 1976 to investigate the properties of Martian soils.

In the 1970s, Ron became convinced that centrifuges should be used in the United States to advance knowledge of the dynamic properties of soils and soil structures, particularly when subjected to strong earthquake motions. Centrifuges had been used to study soils in the Soviet Union, but with the exception of P. B. Bucky at Columbia, who used them to study problems related to mining, they had not been used in the United States. A centrifuge is a valuable tool, Ron argued, because the mechanical properties of soils depend on the overburden pressure. For example, deeper soils, which are under more pressure than surface soils, have higher failure levels than the same kind of soil near the ground surface. Thus to test a 1/100 scale model of an earthen dam made of the same material as the full-scale prototype, the soil must be subjected to an effective gravity 100 times the gravity of the Earth.

In 1975, Ron convened a workshop at Caltech to bring the potential value of this method to the attention of U.S. researchers. The conference introduced the first research in the United States using centrifuges, and they are now widely used and acknowledged to be extremely valuable for studying soil mechanics. In his introduction to the workshop, Ron's famously dry sense of humor was on display in an illustrated history of the uses of centrifuges in science and engineering, chiefly in medicine. At the time, centrifuges were used for the treatment of the mentally ill, and a spinning platform had been patented for using centrifugal force to facilitate childbirth.

For Ron's first centrifuge research, he adapted a small centrifuge he had obtained from NASA for research on soil mechanics. Installed on the roof of a Caltech building, the machine had a 40-inch radius and could accommodate models whose largest dimensions were approximately one foot. In a series of experiments in the late 1970s and early 1980s, Ron and his coworkers—students, postdoctoral fellows, and engineers from industry—performed experiments on the performance of piles for offshore drilling structures, the behavior of anchors for the support of guyed offshore towers, dynamic pressures on retaining walls during earthquakes, the mechanics of fault rupture in rock and alluvium, and the earthquake behavior of foundations and footings.

These experiments were not easy to perform. The modeling requirements meant that time in the model had to run much faster than time in the prototype. For example, a 20 to 30 second earthquake accelerogram had to be compressed into 2 or 3 seconds of model excitation, and it had to be applied by a small shaker in a high-g environment in a bucket spinning many times a second within a closed cage. Data, typically strains and pressures, were extracted electronically through sliding contacts at the central shaft, and time-dependent displacements were recovered through the use of mirrors and high-speed photography.

The results were very important in advancing the state of soil mechanics. Because large earthen structures could not be subjected to failure-level stresses, the results of the centrifuge tests provided the best available experimental confirmation of engineering calculations and design methods.

Another of Ron's interests was landslides and dam failures. He was a consultant on the Baldwin Hills Dam failure in Los Angeles in 1963, and he studied the disastrous Bluebird Canyon landslide in Laguna Beach in 1978. By studying a small landslide in Los Angeles, which moved slow enough to be analyzed, he was able to make measurements of the motion on the slide plane and document the observed pulse-like character of the sliding.

Ron received many awards for his contributions to the advancement of soil mechanics, among them the Huber Research Prize, the Norman Medal, and the Thomas A. Middlebrook Award from the American Society of Civil Engineers (ASCE) and the Newcomb Cleveland Award from the American Association for the Advancement of Science. He was the ASCE Terzaghi Lecturer in 1983 and the British Geotechnical Society Rankine Lecturer in 1987. He was also a Guggenheim Fellow and a Churchill Fellow at Cambridge University, England. In 1995 he received an Honorary Doctorate of Engineering from his alma mater, the University of Glasgow. Ron was the author of four books, over 250 papers, and holds four United States patents.

He leaves behind his wife Pamela J. Scott, his sons Grant Fraser Scott, Craig Alistair Scott, Roderick Jonathan Scott, and nine grandchildren.

BY PAMELA J. SCOTT
SUBMITTED BY THE NAE HOME SECRETARY

Ron was a kind, thoughtful and loving husband and father to our three sons. Although he was extremely busy with his work at Caltech and his involvement with the space program in the 1960s, he always made time to spend with his three small boys.

Ron was a very keen and competent golfer. He taught the boys golf at an early age, and Grant especially enjoyed playing with his father, with the junior PGA and on his high school team. I also took up the sport although I preferred tennis. We made a pact shortly after our marriage that I would learn to play golf if he would take tennis lessons. Consequently, throughout the years when the boys were home, we would all play tennis and golf together.

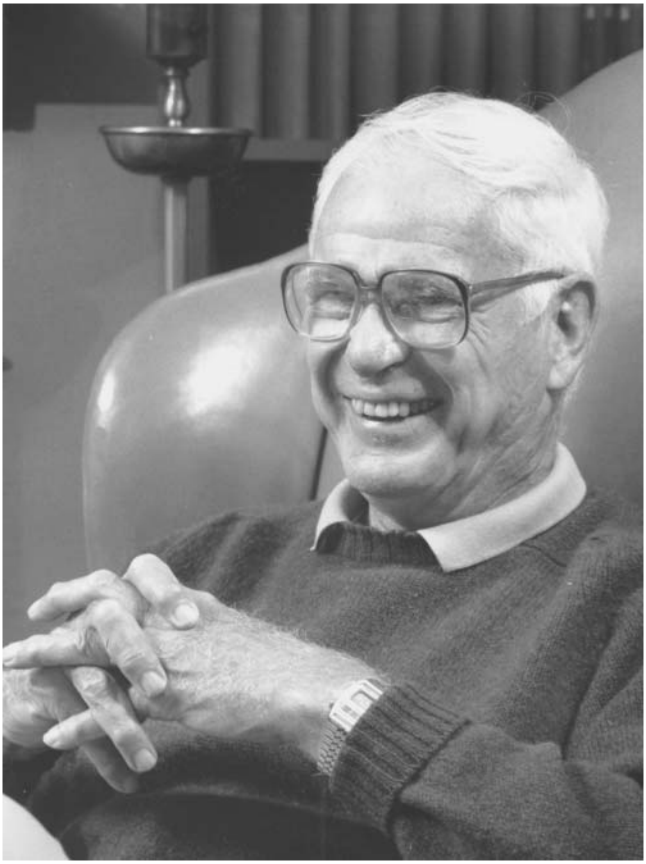
Ron was proud of their athletic prowess and would enthusiastically watch their high school games: Grant tennis, soccer, and golf, and Craig and Rod soccer, swimming, and water polo. Craig and Rod were Eagle Scouts with the honor of carrying the banner in the 1979 Rose Bowl Parade when Jimmy Stewart was the Grand Marshal. We all loved to hike and we spent many happy hours in the local mountains and national parks and also hiked and camped in Europe and Hawaii.

We all love to read and it was Ron who instilled a love of books and reading in our lives. To quote Grant's remarks at the memorial gathering, "My father cultivated a love of literature and was an omnivorous reader . . . he loved words especially puns where there was slippage in the slope of language, perhaps a kind of liquefaction where two letters supporting a dam of meaning gave way or there was semantic friction or failure. He liked to see words collapse into other words and watch as a seismic shift altered the landscape of a sentence."

Ron was not only a husband and father but our best friend, always approachable with advice, guidance, and a marvelous sense of humor.

Acknowledgment

Paul C. Jennings wishes to acknowledge that some of the information and quotations in this tribute are taken from articles in *Engineering & Science,* published by the California Institute of Technology.



ROBERT C. SEAMANS, JR.

1918–2008

Elected in 1968

"For engineering design and development of airborne systems; technical leadership in the nation's space program."

BY SHEILA E. WIDNALL

ROBERT C. SEAMANS, JR. one of the nation's outstanding engineering leaders, senior administrator for several federal agencies, and former president of NAE, died on June 28, 2008, at the age of 89.

Associate administrator, then associate and deputy administrator of the National Aeronautics and Space Administration (NASA) from 1960 to 1968, Dr. Seamans helped lead the nation's space program from its infancy to its triumphant Apollo successes. He was secretary of the Air Force from 1969 until 1973 and became president of NAE in 1973. In 1974, he became the first administrator of the Energy Research and Development Administration (ERDA), predecessor to the U.S. Department of Energy.

Robert Seamans was born on October 30, 1918, in Salem, Massachusetts. He attended Lenox School, in Lenox, Massachusetts, and earned a B.S. in engineering from Harvard in 1939, an M.S. in aeronautics and astronautics from the Massachusetts Institute of Technology (MIT) in 1942, and a D.S. in instrumentation from MIT in 1951. As part of his doctoral work, he assisted Charles Stark Draper, a pioneer in gyroscope guidance, in developing tracking systems that enabled Navy ships to target enemy planes. Those systems were later used for missile navigation and eventually to guide Apollo astronauts to the Moon.

From 1941 to 1955, Dr. Seamans held teaching and research positions at MIT, working on instrumentation and control of missiles and aircraft. In 1955, he joined the Radio Corporation of America (RCA) as manager of the Airborne Systems Laboratory and chief systems engineer. In 1958, he became chief engineer of the Missile Electronics and Controls Division at RCA.

In 1960, he joined NASA as associate administrator, and in 1965, he became deputy administrator. He also performed general-management responsibilities and served as acting administrator. Dr. Seamans worked closely with the U.S. Department of Defense (DOD) in coordinating research and engineering programs, serving as co-chair of the joint DOD/NASA Aeronautics Coordinating Board, which kept both DOD and NASA aware of NASA's activities that were relevant to national security.

Dr. Seamans played a central role in the Apollo Program, both in the technical achievement of the mission and in the initial decision and commitment to undertake the program. He worked closely with the Kennedy administration to fulfill Kennedy's pledge to land a man on the Moon. Dr. Seamans' retrospective of the lunar landing program is documented in a monograph, *Project Apollo: The Tough Decisions* (Monographs in Aerospace History Number 37, NASA SP).

With his unusual skills, Dr. Seamans was able to help achieve the ambitious goal of a manned lunar landing. In an introduction to Apollo Expeditions to the Moon, a history of NASA, he described the monumental technical and organizational challenges involved in carrying men to the Moon and bringing them back safely. "As planning for Apollo began, we identified more than 10,000 separate tasks that had to be accomplished to put a man on the Moon," Dr. Seamans wrote. "Each task had its particular objectives, its manpower needs, its time schedule, and its complex interrelationship with many other tasks." With his trademark attention to detail and his ability to cut problems down to size, he tackled the most daunting tasks. Colleagues commented that he had a remarkable ability to get to the essence of things and could take complicated issues and make difficult decisions quickly. No matter what, he kept moving forward toward the goal.

In January 1968, he resigned from NASA to become a visiting professor at MIT, and in July of that year, he was appointed the Jerome Hunsaker Professor, an MIT-endowed visiting professorship in the Department of Aeronautics and Astronautics named in honor of the founder of the Aeronautical Engineering Department. At the same time, Seamans remained a consultant to the administrator of NASA. Also in 1968, not only was Dr. Seamans elected to the National Academy of Engineering, but he was also appointed secretary of the Air Force. When the appointment was confirmed in 1969, he became a member of a burgeoning elite of government and industry scientist-administrators. At the beginning of his term as secretary, he recognized that the Air Force had to modernize, quickly and with as little expense as possible. This, he knew, would require more efficient management controls. The Air Force had to phase in programs in such a way that excessive peak demands on the budget were avoided. Because it was impossible to predict future threats or the technological innovations that would be required, Seamans argued that the Air Force should provide development options from which it could select necessary procurement programs.

After two years in office, Seamans, who had planned to stay for only two years, informed Secretary of Defense Melvin Laird that he wished to extend his tour to complete or initiate several projects. He wanted to place the C-5 contract with Lockheed on a sound basis; resolve the F-111 cost and technical difficulties; move new programs, such as the F-15, B-1, AWACS, A-X, and F-5E, to a point at which the Air Force could be confident in its policy of "fly before buy"; and improve military and civilian personnel policies. His willingness to stay, however, depended on the administration's determination to end U.S. activities in Southeast Asia.

In May 1973, when Seamans finally left DOD to become president of NAE, President Richard M. Nixon said that his administration was fortunate to have had a person of Seamans' leadership and managerial ability directing the development of sophisticated new aircraft and helping to improve U.S. missile systems. Nixon credited Seamans with keeping the Air Force modernization program costs very close to projected estimates and for creating an environment in which people serving in the Air Force believed they could realize their potential.

In 1974, President Gerald R. Ford named Dr. Seamans the first administrator of the Energy Research and Development Administration (ERDA), which, with the Nuclear Regulatory Commission, had replaced the Atomic Energy Commission. ERDA was the precursor of the U.S. Department of Energy. With an annual budget of about $6 billion, a staff of more than 7,000, a complex of federal laboratories and contracts with universities and industrial research organizations, Dr. Seamans faced the fallout from the Arab oil embargo of 1973–1974. On his first day in the job, he said, "There is no way we can become self-sufficient in 10 years or any time in the future if we keep increasing the use of energy."

Important steps in energy conservation, he said, would be the development of automobiles that get more than 40 percent better gas mileage and the design of buildings that would be less expensive to heat and cool. His agency's first report to Congress in 1975 emphasized increasing production of nuclear power, coal, shale oil, crude oil, and natural gas over the next decade. But within a year, the report was revised, to indicate that ERDA would give "the highest priority" to energy conservation. In 1974, shortly after he was named head of ERDA, Dr. Seamans told *The New York Times,* "We are never again going to have a cheap-energy situation, and we have got to use every string in our bow if we are going to maintain the lifestyle of this country."

Dr. Seamans returned to MIT, and, in 1978, became dean of the MIT School of Engineering. In 1981, he was elected chairman of the board of the Aerospace Corporation. From 1977 to 1984, he was the Henry Luce Professor of Environment and Public Policy at MIT, where he remained a senior lecturer in Aeronautics and Astronautics. In 1996, he published his autobiography, *Aiming at Targets* (University Press of the Pacific, 2004).

Bob Seamans was an avid sailor and devoted family man. He and his wife, Eugenia, recently celebrated their 66th wedding anniversary. Immediately before his death, he was still playing tennis and looking forward to voyages on his refurbished 45-foot Bristol sailboat. In addition to his wife, Dr. Seamans leaves two daughters, Katharine Padulo and May Baldwin, and three sons, Joseph, Robert III, and Daniel, as well as 11 grandchildren and two great grandchildren.

HERMAN E. SHEETS

1908 – 2006

Elected in 1967

"For ship and submarine design."

BY STEVE LEVINSON
SUBMITTED BY THE NAE HOME SECRETARY

HERMAN ERNST SHEETS, emeritus professor and chairman of the Department of Ocean Engineering, University of Rhode Island, died April 22, 2006, surrounded by his family at his home in Groton, Connecticut. He was 97 years old. Sheets had long, distinguished careers as an inventor, engineer, manager, university professor, department chair, and consultant to industry and government.

Born in Dresden, in the Kingdom of Saxony, on December 24, 1908, Sheets (birth name Chitz) was educated in Germany and Czechoslovakia; he earned his Diplom-Ingenieur in mechanical engineering from Technical University in Dresden, highest in his class of 1934. He then graduated in 1936 from Charles University-Technical University, in Prague, with a Doctor of Technical Sciences degree in applied mechanics and the award for excellence. He began his career designing fans, pumps, and steam turbines for Erste Bruenner Maschinen Fabrik in Brno, Czechoslovakia.

Although he was baptized a German Lutheran, Sheets' Jewish descent forced his departure from Czechoslovakia in 1939 just ahead of the German army. He emigrated to the United States, sponsored by maternal relatives in this country. He then obtained and sent visas to his parents in 1940, but it was too late for them to escape. Years later he learned that they had been deported from Dresden to Riga where they perished.

Offered a position at MIT, the entrepreneurial Sheets decided instead to join a small Midwestern engineering firm, Chamberlin Research Corporation. In 1942, when the company began manufacturing washing machines for the U.S. Army, Sheets, by then a U.S. citizen, joined the St. Paul Engineering Company where he developed hydraulic machinery and valves, including valves for the Manhattan Project. In 1944, the Manhattan Project transferred him to the Elliott Company in Jeannette, Pennsylvania, where he worked on the development of pumps (for the fluids for which he had designed and built valves at St. Paul Engineering) and compressors (including the first supersonic compressor). The Manhattan District Project awarded him a citation in 1945 for his work on gaseous diffusion.

Sheets left Elliott in 1946 for Goodyear Aircraft Company, where he engineered rockets, until Booz-Allen recruited him for General Dynamics in 1952 as chief scientist-engineer for the new nuclear submarine program at its subsidiary, Electric Boat (EB) Company. There he created and led a state-of-the-art laboratory for which he recruited a staff of scientists and engineers, including Dr. Yost Van Woerkom, Dr. Lester Chen, Dr. Bjorn Lund, Allan Anderson, Kurt Lawrence, and Agnes Summers, the first woman engineer at EB. He continued to tap the talents and resources of men with whom he had worked at St. Paul Engineering (Ralph Jones and Evan Johnson), Elliott (Dr. Andrew Vazsonji and Dr. Judson Swearingen), and James G. Wenzel, Lockheed Marine Systems Group.

Under Sheets' direction, EB launched the Nautilus in 1954 and the Sea Wolf in 1955. In 1959, the Nautilus made a historic undersea voyage from the Pacific to the Atlantic via the North Pole. In 1960, the Triton circumnavigated the globe submerged for 84 days. In 1962, EB completed the first Polaris submarine—the George Washington—with a missile-firing range of 1,200 miles and a capacity of 16 nuclear-tipped missiles. In 1969, EB launched the Narwhal, a submarine that used a natural convection reactor, which eliminated noisy pumps and made it the quietest and stealthiest vessel in the fleet.

Dr. Edward H. Heinemann, an aeronautical engineer and vice president of engineering at General Dynamics Corporation, a leading influence on Sheets and a prominent supporter, nominated him to the National Academy of Engineering in 1967.

At Erste Bruenner in Brno, Czechoslovakia, Sheets had invented and patented the slotted-blade fan, and the Czech company had generously given Sheets the world rights to the patent. Because of its quiet operation, the fan (also known as the vane-axial fan) eventually found its way into U.S. Navy submarines. Sheets continued to improve upon the original design at EB and in retirement; he obtained new patents as late as 1988 and 1991. Probably one of the least known weapons of the cold war, fans are crucial for air circulation in the confined space of an underwater craft. The new cylindrical device was much quieter than the earlier fan, and on U.S. submarines, where stealth was considered more important than speed or the ability to dive deep, quietness was next to godliness.

Another variant of Sheets' invention was a fan that operated at 24,000 revolutions per minute in the very tight confines of a jet fighter. However, in actual operation, the fan encountered some serious problems. First, it generated a lot of noise, although this was tolerable in a jet fighter. However, it also had a short operating life, and when it failed, it failed abruptly putting the aircraft and pilot at extreme risk.

The pilot had to be alerted that the bearings were about to fail far enough in advance to land the plane safely and have a new fan installed. Sheets discovered that about two hours before the bearings failed, an electric current imposed across the lubricant film underwent a change that could be measured. Thus, by maintaining an electric current, the pilot had a two-hour warning that the fan would fail, enough time to reduce the fan requirements and/or land the plane.

With the specific goal of keeping EB profitable and its engineers and skilled workers employed and loyal between submarine contracts, Sheets set to work developing and selling EB specialties, including vane-axial fans for electronic package cooling and for use in marine and commercial heating and ventilating systems and electronic spot-cooling fans; ball valves and actuators (low- and high-pressure ball valves and a three-position hydraulic-valve actuator); vibration-measuring equipment (a vibra-force analyzer, an automatic 1/3-octave band analyzer, and a dynamic vibration absorber); and industrial control systems for hot- and cold-strip steel mills. Also under Sheets' direction, EB produced systems designed to control the tilt of radio telescopes and systems to regulate the air velocity in supersonic wind tunnels, as well as controllable-pitch propellers for tugs and fishing boats and a hovercraft. In addition, Sheets came across a patentable welding process invented by two EB welders; he obtained a patent for them and arranged for the royalties to be paid to them.

Other notable projects were the all-aluminum Aluminaut, financed by the Reynolds Company, and a series of small one- and two-man submersibles for commercial exploration and research (the Asherah and Star 1,2, and 3), funded by General Dynamics. The latter led to the Navy-financed NR-1 nuclear-powered research submarine. Sheets' lab was directly involved in two projects, AUTEC (Atlantic undersea test and evaluation center) and the NR-1. AUTEC was a pair of deep-diving, two-man, battery-powered submersibles that were larger and more sophisticated versions of the Star vessels. NR-1 was ostensibly an oceanographic research vessel, but it could also be used for other purposes. However, Sheets' main interests were in furthering oceanographic research and diversifying EB's products and interests.

Immediately after his retirement from EB, Sheets joined the Board of Technical Audit Associates, founded by Frank Jewett, Jr., and also began consulting for General Electric Corporation in Cincinnati, Ohio, and Lynn, Massachusetts, on the testing, development, and installation of gas turbines in ships LM2500, LM1500 and LM5000. He was also offered full professorships by MIT, the University of Texas, and the University of Rhode Island (URI), which was closer to home. He attributed these offers to his membership in NAE. With three children still in local schools, Sheets decided to accept the offer from URI. Just a few months later, in 1970, his wife Norma died. Sheets was department chairman at URI until his mandatory retirement at 70 in 1979.

Sheets' first major project at URI was the construction of a building to house the recently created Department of Ocean Engineering; the building, on the Naragansett Bay Campus, included a tow tank. He was particularly proud of having completed the task without asking for money from the university or the Rhode Island legislature. Years later, under the leadership of then chairman Dr. Malcolm Spaulding, the university refurbished the building and named it after Sheets. Spaulding credits Sheets' managerial skills for the success of the country's first ocean engineering department.

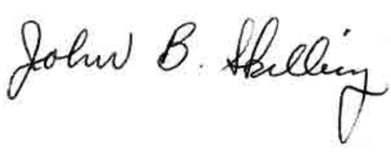
After his second retirement in 1979, Sheets became principal scientist for Analysis and Technology, Inc., in Stonington, Connecticut. The next year he met Paulann H. Caplovitz, an assistant attorney general of New York, who had retained him as a consultant to evaluate the apparently negligent disabling of the Indian Point 2 nuclear power plant on the Hudson River. Sheets married her two years later and brought her and her two young children, Abigail and Gideon, from New York to Groton. By then, Sheets' six children were grown, educated, and launched. Sheets concentrated all his energy and devotion on work and his family. He confided to his second wife that his greatest satisfaction was when his children, grandchildren, and stepchildren returned home for visits.

After leaving Analysis and Technology in 1984, Sheets worked for a number of specialized marine-related or fan companies in the area, including Ship Analytics, Sonalysts, Epoch Engineering, General Systems Solutions, Inc., and EGG-Rotron Corporation. He retired a third time in 1994 at the age of 84 to focus on projects that occupied him until shortly before his death in 2006. These projects included the application of cold war/space age technologies to commercial products, such as ultrasonic washers and microwave dryers; an "underwater (cylindrical) sail" (based on Flettner's concept) for yachts and submarines; and residential wind turbines. He read his last professional paper in 2003 to the Society of Naval Architects and Marine Engineers, when he also filed his provisional and last patent application for his underwater sail.

Sheets was a tireless contributor to professional societies—the American Society of Mechanical Engineers, American Association of the Advancement of Science, American Institute of Aeronautics and Astronautics, Society of Naval Architects and Marine Engineers, American Society of Naval Architects and Marine Engineers, Marine Technology Society, and Pi Tau Sigma. He also served on committees and boards for the Department of the Navy, NAVSHIPS Shipbuilding Industry Advisory Committee, 1963–1968; the Secretary of the Navy's Oceanographic Committee, 1968–1977; the NAE Committee on Ocean Engineering, 1966–1968 and Marine Board 1968–1976; the National Research Council Maritime Research Board, Ship Design, Response, and Load Criteria Advisory Group, 1976–1979; and National Research Council Maritime Transportation Research Board, Ship Research Committee, 1979–1982; the Congress of the United States Office of Technology Assessment, Consultant on Renewable Ocean Energy Sources, 1977–1978 and on Ocean Thermal Energy, 1980; and U.S. Department of Energy, Ocean Systems Branch, 1979–1982. In addition to his 26 patents, Sheets authored or co-authored 45 professional papers and seven books.

Sheets combined Old World manners and American informality in a charming way. A reserved but kind man with a droll sense of humor, he could be coaxed into telling stories from his working life that had the shape of little dramas accented with touches of the ridiculous. He began each day be reading the comics, especially his favorite, "Snoopy." Winner of the all-Saxony decathlon competition in 1929, Sheets remained physically active all his life; despite two hip replacements, he swam weekly until a month before he died.

Sheets is survived by his wife, Paulann H. Sheets, Esq., six children, Lawrence E. Sheets, St. Paul, Minnesota; Michael R. Sheets, Poughkeepsie, New York; Arne H. Sheets, Novato, California; Diana E. Sheets, Ph.D., Champaign, Illinois; Elizabeth J. Sheets, Los Angeles, California; Karn Sheets Ryken, Chelmsford, Massachusetts; and two stepchildren, Abigail P. Caplovitz, Esq., Shelter Island, New York; and Gideon P. Caplovitz, Enfield, New Hampshire; and seven grandchildren.



JOHN B. SKILLING

1921–1998

Elected in 1965

"Pioneering building engineer."

BY WILLIAM J. BAIN, JR.
SUBMITTED BY THE NAE HOME SECRETARY

JOHN B. SKILLING was one of the greatest men I have known—a legendary structural engineer, a lyrical designer, and one of the top conceptual skyscraper engineers in the world. In the 1960s, *Engineering News-Record* (ENR) called him the prototype of the modern structural engineer. Years later, mainstream media dubbed him the Man of Steel. A true innovator, John B. Skilling died in Seattle on March 5, 1998, at 76, just two years after retiring from Skilling Ward Magnusson Barkshire.

John was born on October 8, 1921, in Los Angeles. He entered the engineering field early when he worked on federal construction projects during the summers with his father, who was a civil engineer. These projects took his family from city to city, eventually bringing them to the Pacific Northwest, where John would later put down roots and raise his own family.

After graduating from Kent Senior High School in 1940, John enrolled at the University of Washington. When the war intervened, he worked at the Boeing Company, for which he later designed hangars with impressive long-span roofs. After the war, John returned to the University of Washington, where he earned a B.S. in civil engineering in 1947.

John then joined the structural engineering firm of W. H. Witt Company, where he was made a partner after just three years. The firm subsequently underwent several incarnations and name changes, but John stayed with the firm for 50 years—his entire professional life. When John eventually took over as head of the firm, it became known as Skilling Ward Magnusson Barkshire. Under John's leadership, the company was responsible for the structural engineering of more than 1,000 buildings in 36 states and 16 countries, garnering more than 85 awards for excellence in structural design.

According to *Who's Who in Engineering* (1998), John was "personally responsible for the structural design of many of the most significant structures in the U.S." These structures included more than 75 high-rise buildings (four of the world's 10 tallest at the time) and more than 40 long-span structures.

Early projects included the IBM Building (1963) in Pittsburgh, the first exterior-space-frame office building and the first building to use 100,000 psi high-strength steel.

For the Seafirst Headquarters Building (1969) in Seattle, John used a Vierendeel truss to form the exterior walls. All loads were carried by the four corner columns and the central elevator core, which left flexible spaces on the upper floor interiors that were free of columns and open, uninterrupted entrances to the building from the plaza.

These engineering innovations plus the original structural design of Seattle's IBM Building (1964) led to receiving the commission to engineer the quarter-mile-high twin towers of the New York World Trade Center (1972). John and colleague Les Robertson used three studies that were "firsts" in the field; a comprehensive wind-environmental study, a boundary-layer wind-tunnel study, and a human-sensitivity-to-building-motion study. The World Trade Center was also the first building to use prefabricated, multiple-column-and-spandrel steel wall panels. And it was the first building to use mechanical damping units to reduce wind excitation. The buildings withstood a bombing attack in 1993 but unfortunately were unable to survive the dual terrorist attack in 2001.

For Seattle's Kingdome (1976), John and his colleague John (Jack) V. Christiansen made good use of John's pioneering work in the 1950s on thin-shell concrete structures. With double curvature shapes in the roof, the Kingdome became the largest thin-shell concrete structure in the world.

John's Seafirst Headquarters Building had only four exterior corner columns, but even those four were eliminated for the Rainier Tower (1977). The result is a daring, flared, concrete pedestal that covers only a quarter of the site at ground level allowing for more open views of the surrounding classical buildings. The first rental floor is 12 stories above the ground, providing excellent views and, thus, higher leasing rates. This concept, created by John, is an example of how much responsibility he had for the architectural forms of his buildings.

At 76 stories, John's Columbia Seafirst Center (1985), still Seattle's tallest building, was the first in which composite columns were used at the apexes to reduce wind sway in a triangular-braced building. It was also the first time multilayer viscoelastic dampers were attached to the braces of a high-rise building to reduce wind-induced accelerations.

For the Washington State Convention and Trade Center (1988), John conceived of economical, yet creative ways for the building to span 12 lanes of freeway and three city streets. To accomplish this, he used braced, multichord trusses, which required more than 2,500 different structural-steel connection details.

One of the last projects I worked on with John was Seattle's Two Union Square (1989), at the time, the most economical building of its height ever built. In this building, he pioneered the use of steel tubes filled with a record-breaking high-strength concrete of 20,000 psi as interior columns. Using this technique, which has since become standard in the industry, we were able to provide 10 corner offices on each typical rental floor. By developing hyper-efficient viscoelastic dampers, he reduced the number of necessary dampers to only 16 for the entire 56-story building.

Throughout his career, John received formal recognition from many leading organizations in his field, as well as from the city of Seattle. In 1965, he was the first structural engineer ever to be elected a member of NAE. The following year, ENR named him Construction Man of the Year. My own profession awarded him the American Institute of Architects (AIA) prestigious Allied Professions Medal, as well as an honorary membership in the AIA Seattle chapter. John was named Engineer of the Year three times—by the Consulting Engineers Council of Washington (now ACEC), by the Structural Engineers Association of Washington, and by the Washington Society of Professional Engineers. He also shared an American Iron and Steel Institute Design in Steel Award with Minoru Yamasaki and Perry Johanson. John owned 13 patents related to railcar suspension. Seattle Mayor Norm Rice declared June 3, 1994, John Skilling Day.

In addition to his membership in NAE, John was affiliated with many organizations including American Society of Civil Engineers (Fellow); American Concrete Institute (ACI); ACI Committee on Shell Construction; American Institute of Steel Construction; International Association for Bridge and Structural Engineering; International Association for Shell and Spatial Structures; National Research Council Building Research Advisory Board; Seismic Design Committee, National Academy of Engineering; Society of American Military Engineers; and Structural Engineers Association of Washington.

John was the most positive, solution-oriented engineer I have ever met. No matter how difficult the problem, he always thought that somehow an effective design solution could be worked out. I believe he was a genius. It was amazing to watch him play with forms in the most lyrical and poetic ways and reduce construction costs at the same time. He was also a teacher; he understood the complexities of structural engineering so well that he made things seem simple, even for us architects with whom he collaborated so well.

John was a fun, upbeat man. He was the kind of person who needed only a flip chart and some markers to make his pitch to the World Trade Center Commission. He was the kind of man who, as the story goes, twisted his own leg back around after a skiing accident. He was proud of his family—his wife of many years, Mary Jane Skilling, who was his perfect counterpart and the rock from which he flew, his children, his profession, and his firm. He was always intensely competitive and had incredible drive, but he was never too busy to stop and explain his concepts to the rest of us in words—and diagrams—so we could understand.

Like his tall buildings that are always in motion, John never seemed to slow down. His brilliance, along with his energy, enthusiasm, and innovation provided momentum for everyone of us who was fortunate enough to work with him.

His daughter, Ann, remembers him:

> As a husband and father, John brought his enthusiasm to everything that he did. Whether it was building a miniature railroad for his children, researching recipes to create an elaborate Chinese dinner, or playing tennis and golf, he always gave a hundred percent. He was also fond of puzzles and games of all kinds, which we frequently played together as a family.
>
> His professional creativity often found a place at home. Most fathers would have built a model airplane with their sons; ours chose to build a full size color TV. To John, there was never a problem that could not be solved and never a reason to be pessimistic about anything life had to offer. His life positive attitude guided our family life.

Survivors include his wife Mary Jane, daughters Susan and Ann, son Bill, and siblings Virginia, Donald, Bill, and Helen.

J. EDWARD SNYDER, JR.

1934–2007

Elected in 1979

"For contributions to the Polaris missile reentry systems and to the National Oceanographic Program."

BY ROBERT A. FROSCH

J. EDWARD SNYDER, JR., Rear Admiral, USN (Ret.), former captain of the battleship *New Jersey*, and former oceanographer of the Navy, died on November 4, 2007, at the age of 83. He was elected to NAE in 1979 for "Contributions to the Polaris missile reentry systems and to the National Oceanographic Program."

Like many naval officers, Ed was born far inland, in Grand Forks, North Dakota, on October 23, 1924, son of a Methodist minister. With great humor and imagination, he built a successful career in the Navy based on engineering and scientific knowledge and the capabilities and skills of a distinguished, idiosyncratic leader and commander. He received his B.S. from the U.S. Naval Academy in 1944, and, after considerable field experience as an engineer and scientist and attendance at the Naval War College, he earned an M.S. in nuclear physics from MIT in 1965.

After graduation from the Naval Academy and service at sea, Ed was put in charge of a technical group assessing blast and radiation damage from the Bikini Atoll nuclear tests. He subsequently held several other technical positions, including head of the technical evaluation of the MK56 fire-control system, research assistant and scientific staff member at Los Alamos Scientific Laboratories (working on initiators for fission and thermonuclear weapons), and head of the evaluation of shipboard engineering for antisubmarine sensing and fire-control systems for escort destroyers. In1957 he was the Navy program manager for the Polaris reentry body (REB) systems being designed and built at Lockheed. As Working with the of the Atomic Energy Commission on the Polaris program, he was responsible for quality assurance for the MkI Polaris REB (including the warhead and fusing devices) and for the REB training program.

Ed later went to sea as commander of a destroyer in a development squadron. In 1963, he became a special assistant to the Assistant Secretary of the Navy (R&D), with responsibility for matters related to ballistic missiles. He was also assigned to be representative of the Secretary of the Navy to the Deep Submergence Review Group, which was created to advise the secretary on possible submarine rescue operations following the loss of the *USS Thresher*. In this capacity, Ed was not only a great asset to the Navy secretariat, especially the Assistant Secretary of the Navy (R&D), but also a lively and sociable member of the office.

When the *USS New Jersey* was activated in 1968, Captain Ed Snyder, her designated captain, was assigned to take her out of mothballs, ready her for deployment, and take her into battle off Vietnam, with a primary assignment for shore bombardment with her 16-inch naval rifles. During the preparation, Ed found ways to modernize and simplify the ship, reducing her manpower requirements and, with an eye to economy, saving the cost of removing the 40mm gun tubs by welding the openings shut and painting the insides blue, thus converting them to swimming pools for the officers and crew. He also replaced the shower in the captain's quarters with a bathtub, which he preferred. (His daughter assisted by painting it red.)

As skipper, he frequently roamed the ship, ate with the crew in their mess hall, celebrated birthdays with them, and provided ship's newsletters for them to send home. His crew both respected and loved him.

While off the coast of Vietnam, a small U.S. naval vessel (commanded by a lieutenant) somehow did not recognize the *New Jersey* and sent a searchlight message: "Unknown vessel—identify yourself." After the message was repeated by the small vessel, with no reply from the *New Jersey* because only its captain could release messages, a third message was sent by the small vessel: "Unknown vessel—identify yourself or we will open fire." In the meantime, Ed had been called and he directed the reply, using the 24-inch searchlight: "AA—New Jersey BB62: OPEN FIRE WHEN READY – FEAR GOD – DREADNOUGHT." ("AA —New Jersey BB62" is the message header; AA stands for "unknown vessel," and BB62 is "Battleship 62." Battleships have been known as "dreadnoughts" since the British first called them that.)

Following the decommissioning of the *New Jersey,* Ed served as chief of staff to the commander of the cruiser Destroyer Force, Atlantic Fleet, and then was promoted to rear admiral; he was appointed oceanographer of the Navy in 1971, a position he held until his retirement in 1979.

One of Ed's first tasks as oceanographer was to consolidate the activities of the Naval Oceanographic Office (NOO), move it, as directed by Congress, to a new location at the Stennis Space Center in Bay St. Louis, Mississippi, and make it a major center of excellence. Against considerable inertial resistance, he succeeded in doing so, and NOO is now a recognized center of excellence that provides oceanographic, meteorological, and hydrographic products of great value to the Navy and the entire oceanographic community.

During his eight years as oceanographer of the Navy, he was "double hatted" in a number of positions, from which he was able to improve coordination in oceanography and ocean engineering among U.S. federal agencies and internationally. These positions included: Naval Deputy to the administrator of the National Oceanographic and Atmospheric Administration, special assistant for oceanographic and polar affairs to the assistant director of the National Science Foundation, special assistant to the assistant secretary of state for oceans and environment, principal point of contact at the U.S. Department of Defense for the Senate National Ocean Policy Study, member of the U.S. House of Representatives Oceanographic Advisory Committee, and U.S. vice chair of the US/USSR bilateral Agreement on Studies of the World Ocean.

Ed was awarded the Legion of Merit, the Secretary of the Navy Certificate of Commendation for his work on Polaris missile reentry systems, the Navy League of the U.S. Rear Admiral W. S. Parsons Award, and two additional Gold Stars of the Parsons Award. He was also a member of Sigma Xi.

He and his beloved wife Mary Louise Snyder, had a son, Edward Snyder III; a daughter, Anne Gibson Snyder; and a grandson, Jesse Edward Stovall.

Ed Snyder was a distinguished engineer and Navy officer and a man of great intelligence, talent, humor, and humaneness. With his ready wit, he could illuminate serious situations with apt, but funny remarks. He will be greatly missed by all of us who knew him and worked with him.

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GEORGE F. SOWERS

1921–1996

Elected in 1994

"For translating theory into practice as a teacher, author, and consultant in geotechnical engineering."

BY PAUL W. MAYNE AND BRUCE R. ELLINGWOOD

IN OCTOBER OF 1996, civil engineering lost one of its giants with the passing of Professor George F. Sowers at the age of 75 after a rather short bout with bone cancer. He was a rare breed of person who truly integrated the practices of geotechnical engineering and engineering geology with research and teaching

"There Were Giants on the Earth in Those Days." That was the title of George F. Sowers' keynote lecture at the 1979 Annual Convention of the American Society of Civil Engineers. This special presentation, called the Terzaghi Lecture, was awarded to just one individual in the profession of civil engineering each year. The year George was chosen to give this talk, the auditorium was packed to capacity.

At first glance, his odd title for a technical lecture might have been about dinosaurs, but true to his intentions, George wove a fascinating story about the details and evidence concerning ancient earthwork construction and rock engineering practices on the North and South American continents dating back several thousand years. George's talk included descriptions of the Aztec pyramids, the great cities of the Incas, Mayan centers, and the Etowah Indian burial mounds in Georgia. Most of us in the geotechnical profession were dumbfounded, because we had been taught that Professor Karl Terzaghi had founded our discipline just a few decades earlier, circa 1925. Now we were presented with proof that our engineering discipline had a much, much longer history. Needless to say, George left an impression that was forever "karst" in stone.

Throughout a long and distinguished career of more than 60 years of participation in civil engineering projects, George had simultaneously worn a number of hats, with equal excellence, humility, dignity, and enthusiasm. However, if one were forced to describe him in one word, it would have to be educator. Regardless of whether he was in front of 60 aspiring civil engineers in an undergraduate geotechnical engineering class at the Georgia Institute of Technology or in the presence of some of the world's leading consultants standing on the abutment of a 300 m high rockfill dam in Malaysia attempting to assimilate the characteristics of the large slide that had just occurred, Professor Sowers always tried to learn something new for himself and to help educate everyone who was present. The infectious enthusiasm with which he did this ensured that his listeners always left with a better understanding and a feeling of accomplishment.

George F. Sowers was born on September 23, 1921, in Cleveland, Ohio, to George B. Sowers and Marie Tyler Sowers. His engineering career began at an early age when, as a teenager, he worked as a part-time engineering aide in heavy foundation and harbor construction with his father's consulting firm. He obtained a B.S. in civil engineering from the Case Institute of Technology in Cleveland in 1942, and upon graduation, spent a few years working as an assistant hydraulic engineer for the Tennessee Valley Authority before serving in the U.S. Navy from 1944 to 1946 as an instructor in electronic servicing. More important, in April 1944, he married a mathematician and hydrologist from the Tennessee Valley Authority named Frances Lott. Over the next 52 years, they become one of the best known and most admired couples on the national and international geotechnical circuit.

Soon after the war, George attended Harvard University, where he had the honor of attending classes given by none other than the "father of geotechnical engineering," Professor Karl

Terzaghi. He also studied under Professor Arthur Casagrande. Sowers received an M.S. in civil engineering from Harvard in 1947 in the areas of soil mechanics, foundations, and engineering geology.

George then moved to Atlanta, Georgia, where, for the next 50 years, he held two positions simultaneously—consultant with the Law Engineering Testing Company (now known as MacTec) and professor in the School of Civil Engineering at the Georgia Institute of Technology. Between 1950 and 1958, George and Frances produced four children: Carol, Janet, Nancy, and George Jr. On the professional side, George held a succession of increasingly senior appointments with both Law Engineering and Georgia Tech. At Law, he was named a vice president in 1955, senior vice president in 1967, and chairman of the board in 1971. After serving in the latter capacity for a number of years, however, he was anxious to return to more technical matters, so he resumed his appointment as senior vice president in 1975. Later, he was named senior consultant for Law Engineering Testing Company.

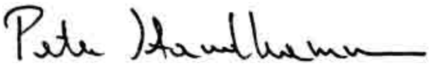
At Georgia Tech, George was appointed professor of civil engineering in 1953 in charge of instruction in soil and rock mechanics and geotechnical engineering. In 1965, he was appointed Regents Professor of Civil Engineering. In addition to balancing and fulfilling his commitments as a consultant and academician, Professor Sowers also found time to participate actively in the activities of professional societies, including the Geotechnical Engineering Division of American Society of Civil Engineers (ASCE), International Society for Soil Mechanics and Foundation Engineering (ISSMFE), Earthquake Engineering Research Institute, National Society for Professional Engineers, American Society for Testing and Materials, Geological Academy of Science, U.S. National Society for Soil Mechanics, U.S. Committee on Large Dams, Seismological Society of America, and Association of Engineering Geologists. In many of these organizations he participated at the highest level, serving on the Executive Committee of the Geotechnical Engineering Division of ASCE and as vice president of ISSMFE.

Professor Sowers was the author or co-author of eight books. His first book, *An Introduction to Soil Mechanics and Foundations*, published in 1951 by MacMillan, was widely acclaimed and was reissued in three editions (1961, 1970, and 1979). In addition to the English version, it has been translated into Spanish and Chinese. During the last year of his life, in failing health, he worked diligently to complete his final book, *Building on Sinkholes: Design and Construction of Foundations in Karst Terrain,* which was published by ASCE in 1996. When he received the first copy directly from the printer and was asked about how long the book had taken to write, he replied, "my whole life." Considering that it contains things he had learned over a 50 year period, that was probably the correct answer.

George was also the author of more than 140 technical papers, many of which received prestigious awards. The excellence of his professional endeavors was recognized with numerous accolades: Teacher of the Year Award at Georgia Tech in 1971; Engineer of the Year Award from the Georgia Society of Professional Engineers in 1973; Herschel Prize from the Boston Society of Civil Engineers in 1976; ASCE Middlebrooks Award in 1977; Terzaghi Lecture in 1979; ASCE Martin Kapp Lecture in New York in 1985; Brooks Award in 1990; ASCE Middlebrooks Award in 1994; ASCE Terzaghi Award in 1995; and ASCE Forensic Engineering Award in 1995. He was elected a member of NAE in 1994.

Notwithstanding his hectic dual careers, intensive travel schedule, professional involvement, community and church activities, and active family life, George Sowers clearly was a giant among his peers. He left a far-reaching legacy through his teachings, writings, and the physical structures he helped design and build, which will ensure that many more will come to know the giant, who, for a few years, many of us had the privilege knowing.

He is survived by his four children: Carol, Janet, Nancy, and George, Jr.; ten grandchildren; and 1 great grandchild. His wife, Frances Sowers, died in 2008.



PETER STAUDHAMMER

1934–2008

Elected in 1996

"For engineering achievements in space systems, plasma and microwave processes, remote sensing, instrumentation, and their application to commercial systems."

BY GERARD W. ELVERUM

PETER STAUDHAMMER, whose scientific and engineering accomplishments in an astonishing variety of science and engineering fields, both commercial and academic, died of cancer on January 14, 2008, at his home in La Quinta, California, at the age of 73. He began his career as a rocket scientist, became vice president and chief technical officer of TRW, and ended his career as director of the Alfred E. Mann Institute for Biomedical Engineering at the University of Southern California (USC).

During Peter's 42-year career with TRW, he held a variety of technical and management positions. He was chief engineer and a principal architect of the Apollo lunar descent engine that soft-landed U.S. astronauts on the Moon. The engine, an entirely new design (10:1 throttling with storable liquid propellant), performed perfectly in seven manned missions, including the first Moon landing and the rescue of Apollo 13. Peter also pioneered hydrazine-fueled rocket engines, now a standard of spacecraft propulsion, and developed space instruments for the exploration of Venus, Mars, Jupiter, and Saturn. The most notable of these was the Viking Biology Experiment, the first such instrument to search for life on Mars.

Under Peter's leadership, TRW's Central Research Laboratories created a plasma-based isotope-separation process and applied it to separating uranium and several transition-metal isotopes, including palladium, which is now used for prostate cancer therapy. He directed a broad range of research in space science, solid-state devices, plasma physics, optics and lasers, and programs in thermonuclear fusion, isotope separation, fossil-fuel combustion, and energy storage. This research established new TRW product lines in GaAs (Gallium Arsenide) microelectronics, SAW(Surface Acoustic Waves) devices, and high-energy lasers.

In 1986, Peter was named vice president and general manager of TRW's Defense Projects Division, where his responsibilities included managing classified programs of great national importance involving systems with both space and ground segments. He was also the first leader of the TRW Center for Automotive Technology, which applied space and defense capabilities to advancing automotive product development. The results were a wide range of performance-, safety-, and efficiency-enhancing projects that led to new billion-dollar automotive product lines for electrically assisted steering and integrated vehicle-stability controls.

In 1993, he was appointed chief technical officer for TRW Inc., a position that required leadership of strategic technology planning for TRW's worldwide force of more than 17,000 engineers and scientists in a huge range of technical disciplines in space, electronics, information, and automotive systems. Few people would even have attempted to meet the mental, physical, and leadership demands of the job. Peter excelled.

During this period, Peter also actively promoted the study of system engineering and leadership principles in engineering education. He served on university engineering review committees at UCLA, UC Riverside, USC, University of Michigan, and Case Western Reserve University. In 1992, he was named Alumnus of the Year by the UCLA School of Engineering.

From 2003 to 2007, as director and chief operating officer of the USC Mann Institute, Peter provided technical and managerial leadership for the research, development, and commercialization of biomedical devices and other technologies. He was also a member of the USC Viterbi School of Engineering Board of Councilors and a research professor in the Department of Biomedical Engineering. At the same time, he was a consultant to Northrop Grumman and the U.S. Department of Energy and a member of the General Motors Corporate Technical Advisory Board.

Peter was born in Budapest, Hungary, on March 4, 1934, to John and Josephine Staudhammer, the second of five children. The Central European world into which Peter was born became progressively darker throughout the 1930s and finally erupted in World War II. His father, a survivor of seven years in a Siberian prisoner of war camp during World War I, knew firsthand the consequences of "liberation" by the Red Army. Therefore, as the Russian army approached Hungary in 1944, the family left, amid tanks and bombs, for the relative safety of Austria. Along with hordes of other displaced persons flooding Western Europe, the Staudhammers moved on to Stuttgart, Germany, where they placed their names on the roll of the International Relief Organization. In 1949, Margaret Zerovean and the Hungarian Catholic Church in Los Angeles sponsored their entry to America.

In Los Angeles, Peter finished high school and entered UCLA in 1952 as a freshman in engineering. He was a research assistant to Dr. Sam Yuster and Dr. William Seyer, who later became his Ph.D. advisor. Peter received his Ph.D. in 1957, just five and a half years after leaving high school, a remarkable achievement considering the difficult conditions of his pre-university life and education.

Upon receiving his Ph.D., Peter applied for a position in the Rocket Motor Injection and Combustion Group, which I headed at the Cal Tech Jet Propulsion Laboratory (JPL). How fortunate I was that he accepted the position! In those days, work on rocket technology at JPL was still pretty primitive. Slide rules and Freidan calculators were the tools of the trade. Rocket motor tests were observed through a window in a block wall, and sometimes propellant flows were controlled with hand valves. Peter's experiences at JPL working directly with hardware at the cutting edge of rocket-motor technology resulted in his lifelong desire for hands-on participation in projects. That desire, combined with his outstanding technical capabilities, led to the brilliant achievements that characterized his career.

With the planned transfer of the Cal Tech JPL management contract from the Army Missile Command to NASA at the end of 1958, the future of rocket technology and development at JPL was uncertain. In October 1958, Space Technology Laboratories (STL) had become an independent subsidiary of the newly formed Thompson Ramo Wooldridge, Inc., with Dr. Louis Dunn, a former director of JPL, as president. Dr. Dunn encouraged several of us at JPL with expertise in rocket engines to join STL (which later became TRW), which Peter and I both did in early 1959. That was the beginning of our career together at TRW.

After Peter became an NAE member in 1996, he was appointed to the NAE Program Committee, which oversees the planning and execution of NAE programs; he was committee chair from 1998 to 2003. He also served on the NAE Section 12 Peer Committee in 2000 and was chair for the 2003 election cycle. Section peer committees evaluate and make candidate recommendations to the NAE Committee on Membership. Peter's leadership led to an appointment on the NAE Membership Policy Committee from 2003 to 2005, and subsequently to his becoming a member of the Committee on Membership from 2004 to 2007. Peter also contributed to many NRC studies sponsored by the U.S. Air Force, U.S. Department of Defense, U.S. Department of Energy, and NASA. In 2002, he received the Distinguished Public Service Medal from NASA for a lifetime of distinguished service to the United States.

"Pete Staudhammer was an engineer's engineer—a broadly competent engineer both highly analytical and innovative," said Simon Ramo, co-founder of TRW. "He was such a nice man. Everyone—young engineers and senior experts—would come to consult him, as did all of the top executives. He will be greatly missed. The essence of Peter was his deep caring for people. In his own words, 'It's people that you want to bet on, actually much more than talent and much more than inventions.'"

Peter's wide range of interests was reflected in his personal life. He was a devoted follower and supporter of the opera and symphony. At his home in Lake Arrowhead, he enjoyed boating, water skiing, and working in his woodshop. A devoted family man, he took pride in helping his six children achieve success, and he strove to instill in his grandchildren imagination and the quest for knowledge.

Peter is survived by his wife, the former Marie Gilman; three daughters, Debra, Julia, and Christina from his first marriage to June Fochler; two stepdaughters, Jennifer and Hilary; a stepson, Stephen; and seven grandchildren. He is also survived by three brothers, John, Karl, and Fred; and a sister, Josephine Laue.

Peter is also survived by the inspiration he left in the memories of hundreds of colleagues, students, and friends. It was my great privilege to work closely with Peter during his professional career starting in 1957. What a brilliant mind, and what a pleasure to be with! He was a supportive friend who energized my career beyond measure. I will always miss him and remember him with great respect and fondness.

JAN VAN SCHILFGAARDE

1929–2008

Elected in 1989

"For distinguished contributions to agricultural drainage concepts, theory, and design."

BY MARVIN E. JENSON, ERNEST T. SMERDON, AND WILLIAM E. SPLINTER

JAN VAN SCHILFGAARDE, foremost researcher and research administrator in agricultural water management, was born on February 7, 1929, in The Hague, the Netherlands, and died on March 25, 2008, after a long illness, at the age of 79. He was elected a member of NAE in 1989.

Jan's father, who was nearly blind from the age of seven from juvenile cataracts, was a psychologist, philosopher, and translator of books from 28 languages. His mother was the first woman in the Netherlands to receive a law degree, but she married and never practiced law. Thus Jan was from a well-educated family. When he was nine, World War II began. Although the first war years were not too difficult, food and fuel later became scarce, and the schools were closed for last two years of the war. However, the demanding and very intelligent students in Jan's class decided to teach themselves, with only occasional help from teachers. After the war, the teachers passed them all with high marks.

In the postwar years, opportunities to pursue an advanced education in Europe were greatly diminished, so Jan's father, working through a university professor friend in Ann Arbor, arranged for a scholarship for Jan at Hope College in Holland, Michigan. A year later, his father's friend recommended that he transfer to Iowa State College in Ames, where he knew the retired president and where Jan would be able to pursue math and technical subjects.

Having been born in the Netherlands, a nation that depends on good water management for its very existence, it is not surprising that Jan's studies in agricultural engineering were focused on water management. He earned his bachelor's degree in 1949 and his master's in 1950. In 1951, he married Roberta Hansen, and subsequently they had three children, Paul, Mark, and Craig, all of whom have distinguished themselves in their studies and careers.

Jan subsequently established a strong relationship with a world-renowned soil physicist, Don Kirkham, under whom he pursued a Ph.D. specializing in drainage engineering and water-flow theory. Jan received his Ph.D. in agricultural engineering and soil physics in 1954. With Kirkham and Richard Frevert, a professor of agricultural engineering, he published a comprehensive synthesis of drainage theory (Agricultural Experiment Station Research Bulletin 436) in the mid-1950s; that work was later integrated into the 1957 monograph published by the American Society of Agronomy. Jan was a distinguished student at Iowa State and was elected to several honorary societies—Sigma Xi (research), Phi Kappa Phi (scholarship), Pi Mu Epsilon (mathematics), and Gamma Sigma Delta (agriculture).

With Ph.D. in hand, Jan joined the faculty at North Carolina State University (NCSU) with a joint appointment as assistant professor of agricultural engineering and research engineer with the Agricultural Research Service (ARS) of the U.S. Department of Agriculture (USDA), becoming a full professor over time. He taught and conducted research in soil- and water-conservation engineering, as well as research on drainage, irrigation, and hydrology. His signal contributions to drainage theory led to improved drainage-system designs based on transient criteria and rainfall-generated probabilities. His research covered virtually all aspects of subsurface drainage, and he pioneered using a thermocouple psychrometer method for determining the water potential of intact plants. Ultimately, he combined climatic data, statistics, and drainage theory with the results of controlled environmental chambers and outdoor lysimeters to develop methods of predicting crop response.

After 10 years at NCSU, he joined ARS full time in Beltsville, Maryland, as chief water-management engineer for soil and water conservation. At ARS, he not only fulfilled his responsibilities for program leadership and management, but also made important contributions to the technical literature. He ultimately moved up the administrative ladder and became associate director and then director of the USDA Soil and Water Research Program, where he was responsible for overseeing research scientists and engineers in some 80 locations across the country.

With the backing of his superiors, Jan promoted fundamental research directed toward solving practical problems. During visits, in meetings, and in correspondence, he showed a keen interest in the direction and details of research by individual engineers and scientists working on specific problems. He always believed that research managers should serve engineers and scientists, not the other way around. Operating at the interface between science and government policy, he never hesitated to express his opinions about specific issues and to promote novel approaches in irrigation agriculture.

In the 1972 reorganization of ARS, Jan became director of the U.S. Salinity Laboratory in Riverside, California, where his work was focused on irrigation-water management for controlling salinity in the soil, and he was in a good position to explore the environmental and institutional aspects of irrigation-based agriculture.

During this time, he also became involved with interagency teams working on policy and technical issues included in the Colorado River Basin Salinity Control Act of 1974. He was an active participant in discussions about options for reducing the salt load in the Lower Colorado River, as required in agreements with Mexico. Although reducing salt by upstream changes in irrigation water management had been proposed, to the dismay of Jan and others, the government opted to build a desalination plant at the Mexican border, which, however, has never had to be used. Jan also chaired a committee established by the National Research Council (NRC) to assist the U.S. Department of the Interior and the state of California in developing a comprehensive research program on irrigation-induced water-quality problems.

After 12 years, Jan was asked to become director of the Mountain States Area of the USDA ARS, which had extensive research facilities in six western states. He was responsible for managing research in a wide range of disciplines related to agriculture, including water management and hydrology. In 1987, he became director of the newly formed Northern Plains Area, which included eight states and had a research budget roughly twice that of the Mountain States Area. In 1991, Jan was asked to return to ARS Headquarters in Beltsville as associate deputy administrator for natural resources and systems, with the responsibility of coordinating all ARS research in these areas.

Over time, Jan made a gradual shift from strictly personal research, with attention to technical detail, to administrative and management activities, and even to natural-resource policy. As his interest in international resource-management grew, he became more involved in interactions between social and physical sciences to address the urgent need for conservation. Jan became increasingly involved as a volunteer on boards and committees of the National Research Council (NRC) and other groups.

In 1979, Jan was appointed a member of the Presidential Commission for Opportunities to Increase Agricultural Production in Egypt, which submitted a report in 1980. He was a member of the NRC Board on Agriculture from 1984 to 1990; chair of the NRC Committee on Irrigation-Induced Water Quality Problems from 1985 to 1990; chair of the National Academy of Sciences World Food and Nutrition Study, Panel 4 (Resources for Agriculture) from 1975 to 1977; chair of the U.S.-USSR Bilateral Science Exchange Team on Movement of Water, Gas, Salts, and Heat in Soils, for which he traveled to the USSR in 1972, 1974, and 1976; a member of the NRC Committee on Biology and Medicine in Space, which advised NASA on priorities for biological research on the Space Shuttle from 1972 to 1974; and a participant in the Brownell Task Force appointed by President Nixon in 1972 to find a "permanent and equitable solution" to the controversy with Mexico over allocations of Colorado River water. He traveled to many countries pursuing his interest in water management and in increasing food production.

Jan was editor in chief of *Agricultural Water Management,* an international journal published by Elsevier Science Publishers in Amsterdam, 1988 to 1991; was active in many professional societies; and was a fellow or member of eight national and international science or engineering societies. For his scientific and managerial accomplishments, Jan received many awards and honors. He was a fellow of three professional societies—American Society of Agronomy (1969), Soil Science Society of America (1969), and American Society of Agricultural Engineers (ASAE) (1972). His many honors include several technical awards from ASABE (formerly ASAE) and the American Society of Civil Engineers (ASCE), including the ASCE Walter L. Huber Civil Engineering Research Prize in 1970, the ASAE John Deere Gold Medal Award in 1977, the ASCE Royce Tipton Award in 1986, and in 1991, he received an ARS Senior Executive Service Presidential award; he was invited to present the Abel Wolman Distinguished Lecture in Washington, D.C., by the NRC Water Science and Technology Board (1992). That same year, he was made a Distinguished Member of ASCE.

Jan retired from USDA in November 1997. In March of the following year, he and Roberta moved back to Fort Collins, Colorado, where they lived until his death. Also in March 1998, he and Roberta were special guests at the 7th International Drainage Symposium in Florida, in recognition of Jan's role in all six of the previous symposia.

Jan is survived by his wife, Roberta, his three sons, seven grandchildren, four younger brothers, and a very special cousin, two years older, whose Indonesian mother died in childbirth, and who was brought to live with Jan's parents after Jan was born. A sister preceded him in death. Though he was often away from home, Jan was a loving and attentive father, and he encouraged Roberta in her numerous volunteer endeavors. His meticulous math instruction was a great boon for his sons but often was the cause of a huge sigh before help was asked. As the second son said to the third one time after a huge sigh, "I guess you'll have to go to Dad." Huge sighs from both boys. "I know . . . it takes forever, but you sure know what you're doing when you're finished." The hugely benefited sons are known to have used the same technique with their sighing children. Son Paul developed multiple sclerosis in college, having to leave a month before graduation for treatment, but later graduated from home and developed a business as an accountant. Wheelchair bound for 34 years, he and his wife have two grown children. Mark is a theoretical physicist, teaching at Arizona State University. He and his wife have three children. Craig is currently an engineering director in the missile systems group of Northrop Grumman Corporation.

Roberta recalls that a short time after retirement in Fort Collins, Colorado, a grandson, Ari, came to live with them, and they sent him to a private high school in Boulder, 45 miles away. Jan was usually the one who drove Ari to school each day, retrieving him in the afternoon until he could drive himself, and the maturing boy became very grateful to his grandfather. After graduating from college, Ari was granted a ten-month Fullbright Fellowship to teach English as a second language in a Muslim girls' boarding school in Indonesia, and when Jan died, Ari made the three-day trip to Fort Collins from Indonesia for the funeral. He now works for an environmental company in Seattle.

MACELWYN VAN VALKENBURG

1921–1997

Elected in 1973

"For contributions to circuit theory, beacon antennas, servomechanisms, and computer science."

BY TIMOTHY N. TRICK
SUBMITTED BY THE NAE HOME SECRETARY

MAC ELWYN VAN VALKENBURG, former W.W. Grainger Professor Emeritus of the Department of Electrical and Computer Engineering and Dean Emeritus of the College of Engineering at the University of Illinois, Urbana-Champaign, died on March 19, 1997, at the age of 75. He was elected to NAE in 1973.

Mac was born on October 5, 1921, in Union, Utah, the son of Charles M. and Nora Louise Walker Van Valkenburg. In grade school, Mac was inspired by a neighbor boy who had figured out how to use a one-tube, battery-powered radio to amplify sound from a hand-cranked phonograph. Before he was a teenager, Mac and a close friend, Vance Burgon, were making crystal radio receivers from copper coils wrapped around oatmeal boxes and crystals of galena found in nearby copper deposits. The two became amateur radio operators, and their walls were plastered with QSL (one of the Q codes used in radiocommunication and radio broadcasting) cards, postcards from other ham radio operators verifying that their signal had been received. Soon the boys were scripting a radio program based on information from ham radio magazines and their own experiences. The program aired late Saturday night on radio station KSL in Salt Lake City.

After graduating from Jordan High School in Sandy, Utah, Mac enrolled in the electrical engineering program at the University of Utah, where he earned his B.S. in 1943. On August 27 of that year, he married his high school sweetheart, Evelyn June Pate, in Salt Lake City. Since the United States was in the midst of World War II and Mac was a top student, upon graduation he received an assignment to join the staff at the Massachusetts Institute of Technology (MIT) Radiation Laboratory, where he helped develop radar under the direction of the renowned Ernst Guillemin.

In 1946, Mac received his M.S. from MIT and returned to the University of Utah where he taught until 1955, with a leave of absence from 1949 to 1952 to pursue his Ph.D. at Stanford University. Interestingly, his Ph.D. thesis was on the detection of meteor trails in the ionosphere. While at Stanford, Mac was asked to develop a new course on servomechanisms. One can only conjecture that this daunting assignment might have stimulated his interest in circuits and systems.

Mac joined the faculty of electrical engineering at the University of Illinois in Urbana-Champaign (Illinois) in 1955, where he was associate director of the Coordinated Science Laboratory and, for a semester, acting department head. In 1966, he became head of the Department of Electrical Engineering at Princeton University, and in 1974, he returned to Illinois where, in 1982, he was named to the College of Engineering's first endowed chair, the W.W. Grainger Professorship. In 1984, he was appointed dean of the College of Engineering.

Upon his retirement in 1988, Illinois Chancellor Thomas Everhart said, "The renaissance in engineering, which has seen an explosion of new endeavors in the past three years, has been due, in no small part, to the supportive atmosphere Dean Van Valkenburg has embodied and the encouragement he has given to new initiatives."

Although Ernst Guillemin is rightfully called the father of modern circuit and system theory in engineering education, Mac's books made those concepts understandable to the masses worldwide. In an era of dc/ac analysis, the revolutionary time domain/frequency domain transform methodologies were little understood by most engineering educators. The first edition of *Network Analysis* (Prentice Hall) was published in 1955, but Mac's fame as an engineering educator was cemented in 1960 with the publication of his second book, *Introduction to Modern Network Synthesis* (Wiley, 1960). The second and third editions of *Network Analysis* were published in 1964 and 1974 respectively, and his final book, *Analog Filter Design* (Holt Rinehart & Winston) was published in 1982. All of his books were translated into several languages and became standard texts worldwide.

Mac was quick to sense new trends in electrical engineering. In 1963 he organized the first Circuits and Systems Conference at the Allerton Conference Center at Illinois. Most of the notable educators in electrical engineering were in attendance, and many new ideas for research, new courses, and textbooks resulted from the mix of seasoned veterans and young educators and graduate students. This was the kind of intellectual stimulation Mac enjoyed throughout his career. Later he encouraged similar conferences at Princeton, the Asilomar Conference Center in California, and the University of Hawaii. Approximately 10 years later, the IEEE Circuit Theory Society became the IEEE Circuits and Systems Society.

During his career Mac held visiting appointments at Stanford University, University of California, Berkeley, University of Colorado, University of Hawaii-Manoa, University of Arizona, and Indian Institute of Technology at Kanpur. He was also a delegate to the meeting of the 1st International Federation of Automatic Control in Moscow. Mac received numerous honors and awards, including Fellow of IEEE, IEEE Education Medal, IEEE Centennial Medal, American Society of Electrical Engineers (ASEE) Lamme Medal, ASEE George Westinghouse Award, Guillemin Prize, and the Halliburton Award. Mac was IEEE vice president, editor of *IEEE Proceedings* and *IEEE Transactions on Circuit Theory*, and editor in chief of the IEEE Press. He also served on numerous NAE, IEEE, ASEE, and ABET committees and a number of advisory committees for the National Science Foundation and various universities.

As Mac's reputation as one of the foremost educators in electrical engineering grew, demands on his time increased to a level that most people would find intolerable. Between his travels abroad and his keen interest in engineering education, he was a valuable source of information. He served on endless policy and advisory committees and wrote numerous articles on engineering education, including a column in the ASEE *Prism.* Engineering students, educators, and publishers from all over the world sought his advice and counsel. John Whinnery, Professor Emeritus, University of California, Berkeley, confided to me that "Mac is the guru to electrical engineers."

Mac communicated as effectively in the classroom as he did in print. His famous colored-chalk lectures, delivered with infectious enthusiasm, attracted thousands of undergraduates to his courses. He also enjoyed communicating with other professionals and was incredibly loyal to his friends.

Mac's talents weren't limited to communication. With his genuine interest in people and powers of subtle persuasion, he was also a mentor of bright, creative people with open minds. He even encouraged them to write textbooks that would be competitive with his own books. He had a talent for extending horizons and engaging people in professional activities they would never have undertaken on their own initiative. Mac was a father figure to many young people in the profession.

Mac is survived by his children, Charles Mac Van Valkenburg, Kaye Van Valkenburg, David R. Van Valkenburg, Nancy J. Van Valkenburg, and Susan L. Van Valkenburg; and twelve grandchildren. His wife, Evelyn J. Pate Van Valkenburg, and one daughter, JoLynne Van Valkenburg, have passed away since his death.

ROY F. WESTON

1911–2007

Elected in 1976

"Leadership in the multidisciplinary approach to solving difficult waste problems involving municipal waters, industrial wastes, and solid wastes."

BY ANASTASIA BAMIHOS
SUBMITTED BY THE NAE HOME SECRETARY

ROY F. WESTON, born in 1911, was a visionary who saw the need for sustainability decades before it became a watchword for others. Weston founded Roy F. Weston, Inc., in 1957, a leading environmental and redevelopment consulting firm, and was a major contributor to educational initiatives to address global environmental issues.

A Wisconsin native, Mr. Weston received his B.S. in civil engineering from the University of Wisconsin-Madison in 1933 and his M.C.E. from New York University in 1939. He received a D.E. (Honoris Causa) from Drexel University in 1981 and an Honorary Doctor of Science degree from the University of Wisconsin in 1995. Mr. Weston was a registered professional engineer in 18 states and a diplomat of the American Academy of Environmental Engineers.

Weston was an early champion of the idea that environmental problems require multidisciplinary, rather than piecemeal, solutions. He also maintained that preventing environmental problems is preferable to the abatement or remediation and insisted that engineers in his company promote such a holistic approach in addressing their clients' environmental issues.

Weston was one of the first engineers to use environmental sustainability as a criterion for evaluating human activity and a strong advocate for a global approach to environmental problems. A tireless promoter of environmental education, he supported many organizations and schools through personal contributions and financial donations. He donated funds to the University of Wisconsin to establish the Roy F. Weston Center for Sustainability, which focuses on defining, solving, and preventing environmental problems through rational decisions and processes. His donations also provided support for research and laboratory facilities at Drexel University. His gift to the School of Public Policy, University of Maryland, in 2004 was the largest contribution by an individual in the school's history. The gift was an endowment for the Roy F. Weston Chair in Natural Economics and start-up funds for an initiative in natural economics (the integration of fundamental, natural principles of system operation with social-science theory, modeling, and practice).

As an entrepreneur, Roy was consistently ahead of his time; he challenged the status quo and brought together natural and social sciences—all with the goal of making the world a better place. His gifts and donations helped promote research and education "the Weston way"—combining engineering with policy in the new Masters of Engineering and Public Policy Program at the University of Maryland that brings together researchers in many disciplines through the new Center for Integrative Environmental Research. Weston was a major benefactor of the Nelson Institute at the University of Wisconsin and an original member of its Board of Visitors. In 2005, he donated $1 million to the Nelson Institute to help create two annual graduate fellowships, support the Roy F. Weston Distinguished Global Sustainability Lecture Series, and support other sustainability initiatives. This gift established the Roy Weston Program in Sustainability, which is operated by the institute's Center for Sustainability and the Global Environment, in collaboration with the Department of Civil and Environmental Engineering. He set aside additional monies in a trust fund earmarked for the institute as part of his estate.

Mr. Weston accrued a long list of accolades for his accomplishments, including: National Engineer of the Year by the National Society of Professional Engineers in 1973; member of NAE in 1976; Entrepreneur of the Year, Lifetime Achievement Award by Ernst and Young, Inc., and Merrill Lynch in 1990; American Institute of Chemical Engineers Lawrence K. Cecil Award in 1993; and Technology Council of Greater Philadelphia's Legend CEO Award in 1994. He was named in the *Engineering News-Record* 125th anniversary issue, "125 Years . . . 125 Top People" in 1999. In April 2007, he was recognized as a Hall of Fame Award winner for business achievement by the Chester County, Pennsylvania, Economic Development Council.

Roy Weston took a social imperative, addressing the environmental threat to the global quality of life, and turned it into a thriving business. He was chairman of the board and CEO of Roy F. Weston, Inc. for more than 35 years until his retirement in 1991.

In June 2001, Roy F. Weston, Inc., officially changed its name to Weston Solutions, Inc. (WESTON®), and became an employee-owned company. Carrying on the legacy of Mr. Weston's vision, the company delivers integrated, sustainable solutions for environmental restoration, property redevelopment, design/build construction, green buildings and clean energy.

One of the first sanitary engineers hired by corporate America in the 1930s and a pioneer in environmental consulting, he advanced a multidisciplinary approach that has been widely copied. His vision, leadership, and generosity have made a profound impact on the world.

He is survived by his daughters, Katherine Weston Swoyer-Fittipaldi and Susan Weston Thompson, six grandchildren, and 14 great grandchildren. He was married to his high school sweetheart, Madeleen, for over 60 years until her death in 2002.

His daughter, Susan, remembers that for his 95th birthday, the family held a "Roasts and Toasts" celebration. All 125 guests, from around the country, were asked to write a thought or memory of Roy. Many were shared aloud. There were many marvelous, funny, and heartwarming stories showcasing over and over the very human, practical, and optimistic sides of the man from humble beginnings who loved to fish and hunt for food with his Dad, who started a business on a shoestring when few people thought of the environment as a treasure to preserve and who gave opportunities to excel to thousands of employees from almost every nation.

Susan later noted that despite all the awards, tributes and accolades bestowed on him by his peers, to be so honored by his friends, employees and family, that upon her father's return home after the party he said "Now *that* was quite a day!"

Her father had been very involved in the planning of the 95th birthday party including the invitation, which read "Please join us as we gather to celebrate this milestone and look forward to when we reconvene in 2011 for "The Celebration of a Century." Unfortunately he died, surrounded by his family, barely a year after the celebration of his 95th.

Fumitake Yoshida

FUMITAKE YOSHIDA

1913–2007

Elected in 1979

"For leadership in chemical, biochemical, and biomedical engineering in Japan."

BY R. BYRON BIRD AND EDWIN N. LIGHTFOOT

FUMITAKE YOSHIDA, Professor Emeritus in the Chemical Engineering Department at Kyoto University (Japan), passed away on September 5, 2007, after a short illness at the age of 94. His wife Kazuko predeceased him, and he is survived by a son, Hajime, and a daughter, Mrs. Akiko Nakane.

Professor Yoshida was born in Saitama Prefecture on March 20, 1913. In March 1937, he graduated from the Department of Industrial Chemistry of the Kyoto Imperial University, and the following month he accepted employment with the Hitachi Corporation. From April 1940 until October 1945, he was simultaneously employed by Hitachi Corporation and Kyoto Imperial University, where he was a lecturer. At the end of World War II, he severed his connection with Hitachi, and in January 1946, he became an associate professor at Kyoto Imperial University. In March 1951, he obtained his doctoral degree at Kyoto University (the new name for Kyoto Imperial University), by virtue of research on rectification using packed columns. Four months later, he was appointed professor at Kyoto University, where he taught until his retirement on April 1, 1976.

By 1951, the Japanese academic community was ready to make contact with similar communities around the world, and Professor Yoshida played an important role in this endeavor.

His various overseas assignments took him to many countries: 1951 (July) he was a GARIOA (government and relief in occupied areas) student in the United States; from September 1951 to February 1952, he was an auditor at Columbia University; from March 1952 to April 1953, he was a researcher on mass transfer in packed columns at Yale University; from January to October 1959, he was a researcher at the University of Wisconsin; from January to June 1963, he was a visiting professor at the University of California, Berkeley, where he lectured on mass-transfer operations; from July to August 1966, he was a visiting professor at several Australian universities; from July to December 1970, he was a visiting professor at the University of Pennsylvania, where he lectured on biomedical engineering; in February 1974, he was a visiting professor at Tsinghua University, Taiwan; in October 1976, he was a visitor at Ben Gurion University, Israel; and in 1987, he was a visiting professor at Dortmund University, in West Germany.

Professor Yoshida was able to get invitations to these various educational institutions because of his ability to communicate well in English, a rare quality among Japanese engineers. He could explain to people in other countries what was going on in Japan, and he could bring back to Japan accurate information about activities abroad.

Among his activities in professional societies were: director (1955–1959) and vice president (1967–1969) Society of Chemical Engineers, Japan; associate editor, *Chemical Engineering Journal* (1970); Honorary Adviser of *Latin American Journal of Chemical Engineering and Applied Chemistry;* member, American Institute of Chemical Engineers; and editor, *Chemical Engineering Science* (1987–1996).

An activity of particular interest to him was the German-Japan Joint Symposium on Bubble Columns, in which he was a regular participant; his partner on the German side was Professor Doctor Ulfert Oncken of the University of Dortmund.

Professor Yoshida received numerous honors both in Japan and abroad: Honorary Fellow, Society of Chemical Engineers, Japan (1978); foreign associate, NAE (1979); Third Order of the Rising Sun, Gold Rays with Neck Ribbon (1986); Honorary Fellow, Japan Society for Artificial Organs (1987); and Distinguished Service Award, College of Engineering, University of Wisconsin (1988).

From his first visit to Dortmund University as visiting professor in 1981, he was closely allied with that institution. In fact, he often referred to the city of Dortmund as his "German home town." In addition to his numerous scientific contacts with the university there, he established a successful exchange program between Kyoto University and Dortmund. In 1992, an Honorary Doctorate (Dr.-Ing.e.h.) was awarded to him by Dortmund University in recognition of his encouragement of the establishment of cooperation between the two universities. This honorary degree also emphasized that he was an engineer of international reputation.

One of Professor Yoshida's publications on mass transfer was listed as one of the 100 most referenced papers in *Industrial and Engineering Chemistry* for 1975 to 2005. The paper is "Gas Absorption by Newtonian and Non-Newtonian Liquids in a Bubble Column," by M. Nakanoh and F. Yoshida, IEC, Process Design, 1: 190–195 (1980).

In the city of Kyoto, Professor Yoshida founded the Kyoto Association of Host Families (KAHF) in 1984 and served as head of the association. KAHF placed 1,400 foreign students with 360 host families.

Professor Yoshida was co-author of three books (all in Japanese): *Advanced Theories and Calculations of Chemical Engineering,* F. Yoshida and Y. Mori (eds.), Asakura (Vol. 1, 1962; Vol. 2, 1967); *Theories and Calculations of Chemical Engineering,* S. Kamei (ed.) and F. Yoshida (co-author), Sangyo-Tosho, 2nd ed. 1975; and *Chemical Engineering and Artificial Organs,* by F. Yoshida and K. Sakai, Kyoritsu Shuppan, 2nd ed. 1996. In addition, he was on the editorial board of and a contributor to the *Handbook of Chemical Engineering,* Society of Chemical Engineers, Japan, Maruzen (1968).

He also had several hobbies. He was a connoisseur of cameras and photographic equipment, and he had many albums of photographs of his family, his foreign friends, and his own extensive travels. He also enjoyed hiking alone or with students and friends. Even into his 90s, he continued to hike in the mountains around Kyoto.

When his wife, Kazuko, became ill with Alzheimer's disease, Yoshida Sensei took very good care of her. He prepared meals for her, doing the cooking himself, a most unusual undertaking for a Japanese husband.

Note: The authors wish to acknowledge the assistance of Professor Emeritus Masataka Tanigaki of Kyoto University in preparing this memoir.

APPENDIX

Members	Elected	Born	Deceased
M. Robert Aaron	1979	August 21, 1922	June 16, 2007
Malcolm J. Abzug	1996	April 13, 1920	May 23, 2007
Laurence J. Adams	1988	March 13, 1921	February 13, 2008
Oliver C. Boileau	1979	March 31, 1927	July 27, 2007
William M. Brown	1992	February 14, 1932	February 23, 2008
Sir Arthur Charles Clarke	1986	December 16, 1917	March 19, 2008
Steve F. Clifford	1997	January 4, 1943	September 18, 2007
C. Allin Cornell	1981	September 19, 1938	December 14, 2007
Jacob Henrick Douma	1971	May 30, 1912	October 4, 2004
Peter Elias	1979	November 26, 1923	December 7, 2001
Lloyd Edwin Elkins, Sr.	1976	April 1, 1912	December 17, 2004
Frederick J. Ellert	1987	April 8, 1929	July 13, 2005
Ben C. Gerwick, Jr.	1973	February 22, 1919	December 25, 2006
Gene H. Golub	1990	February 29, 1932	November 16, 2007
Charles David Greskovich	2000	June 13, 1942	July 7, 2007
Abraham Hertzberg	1976	July 8, 1922	March 27, 2003
C. Lester Hogan	1977	February 8, 1920	August 12, 2008
John K. Hulm	1980	July 4, 1923	January 16, 2004
F. Kenneth Iverson	1994	September 18, 1925	April 14, 2002
David N. Kennedy	1998	September 10, 1936	December 23, 2007
Philip E. LaMoreaux, Sr.	1987	May 12, 1920	June 23, 2008
William S. Lee	1978	June 23, 1929	July 10, 1996
Tung-Yen Lin	1967	November 14, 1911	November 15, 2003
Arthur Scott Lodge	1992	November 20, 1922	June 24, 2005
Charles Sedwick Matthews	1985	March 27, 1920	May 8, 2008
Dwight Fox Metzler	1973	March 25, 1916	October 30, 2001
Harry O. Monson	1983	February 21, 1919	May 1, 2007
Joseph B. Moore	1986	January 19, 1926	January 7, 2006
James Henry Mulligan, Jr.	1974	October 29, 1920	January 12, 1996
Frank Reginald Nunes Nabarro	1996	March 7, 1916	July 20, 2006
Daniel A. Okun	1973	June 19, 1917	December 10, 2007
Russell Richard O'Neill	1975	June 6, 1916	October 11, 2007
Antoni K. Oppenheim	1978	August 11, 1915	January 12, 2008
John R. Pierce	1965	March 27, 1910	April 2, 2002
Eberhardt Rechtin	1968	January 16, 1926	April 14, 2006
Charles E. Reed	1969	August 11, 1913	November 16, 2007
Robert Clark Reid	1980	June 11, 1924	May 18, 2006
Kenneth J. Richards	2000	November 29, 1932	May 11, 2008
Joseph G. Richardson	1988	October 28, 1923	November 18, 2007
Hunter Rouse	1966	March 29, 1906	October 16, 1996
Mario G. Salvadori	1983	March 19, 1907	June 25, 1997

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Members	Elected	Born	Deceased
Wolfgang Schmidt	2001	February 8, 1942	November 2, 2007
Alexander C. Scordelis	1978	September 27, 1923	August 27, 2007
Ronald Fraser Scott	1974	April 9, 1929	August 16, 2005
Robert C. Seamans, Jr.	1968	October 30, 1918	June 28, 2008
Herman E. Sheets	1967	December 24, 1908	April 22, 2006
John B. Skilling	1965	October 8, 1921	March 5, 1998
J. Edward Snyder, Jr.	1979	October 23, 1924	November 4, 2007
George F. Sowers	1994	September 23, 1921	October 23, 1996
Peter Staudhammer	1996	March 4, 1934	January 14, 2008
Jan Van Schilfgaarde	1989	February 7, 1929	March 25, 2008
Macelwyn Van Valkenburg	1973	October 5, 1921	March 19, 1997
Roy F. Weston	1976	June 25, 1911	August 18, 2007
Fumitake Yoshida	1979	March 20, 1913	September 5, 2007