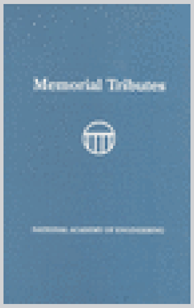


Memorial Tributes: National Academy of Engineering, Volume 14

National Academy of Engineering

ISBN
978-0-309-15218-1

380 pages
6 x 9
HARDBACK (2011)

Memorial Tributes

NATIONAL ACADEMY OF ENGINEERING

NATIONAL ACADEMY OF ENGINEERING
OF THE
UNITED STATES OF AMERICA

Memorial Tributes

Volume 14

THE NATIONAL ACADEMIES PRESS
Washington, D.C. 2011

International Standard Book Number-13: 978-0-309-15218-1
International Standard Book Number-10: 0-309-15218-6

Additional copies of this publication are available from:

The National Academies Press
500 Fifth Street, N.W.
Lockbox 285
Washington, D.C. 20055

800–624–6242 or 202–334–3313 (in the Washington metropolitan area)

http://www.nap.edu

Printed in the United States of America

CONTENTS

FOREWORD

THIS IS THE FOURTEENTH 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

PAUL A. BECK

1908–1997

Elected in 1981

"For pioneering studies in deformation and textures of engineering alloys and in electronic and magnetic characterization of complex alloy systems."

BY EDGAR A. STARKE, JR.

PAUL A. BECK, Professor Emeritus of Metallurgy at the University of Illinois, died in Urbana, Illinois, on March 20, 1997, at the age of 89. He was elected a member of NAE in 1981 "for pioneering studies in deformation and textures of engineering alloys and in electronic and magnetic characterization of complex alloy systems."

Born in Budapest, Hungary, in 1908, Paul attended the Royal Hungarian Technological Institute in Budapest, where he studied mechanical engineering. He subsequently received an M.S. in metallurgy in 1929 from Michigan Technological University and conducted postgraduate research with Professor Michael Polanyi at the Kaiser Wilhelm Institute of Metallurgy in Berlin, Germany, and Pierre Auger at the University of Paris, France. He returned to Michigan Technological University in 1935 to conduct research. He then worked as a research metallurgist in several industries from 1937 to 1945.

He began his academic career in 1945 at the University of Notre Dame, where he later became head of the Department of Metallurgy. He joined the faculty of the University of Illinois as professor of metallurgy in 1951 and retired as Professor Emeritus in 1975. He continued to conduct research and publish in scientific journals until 1989.

Professor Beck began working on recrystallization, grain growth, and textures in metals in the 1930s and continued to work on them at the University of Notre Dame and University of Illinois until about 1970. During that time, he made significant contributions to the concepts of "oriented growth" and "oriented nucleation" of grains. Paul found that the predominant grains in recrystallized samples differed greatly in orientation from the rolled (deformation) texture, often being related to the deformation texture by rotations of 25 to 35 degrees about a common [111] crystallographic direction. In samples with low initial strains (5 to 15 percent), however, the nucleation of new strain-free grains was markedly different; no new orientations nucleated and grew. Instead, existing high-angle grain boundaries moved into their strained neighbors leaving behind strain-free recrystallized regions. This new mechanism of nucleation in recrystallization was called strain-induced grain-boundary migration.

Early in the 1950s, Paul began working on phase diagrams of transition-metal alloys, especially the intermediate phases. Those studies required the fabrication and examination of many samples, which meant enormous labor on the part of his students. Paul worked himself and his students very hard. He was known to phone his laboratory at 8:00 a.m. each morning and ask to speak, in sequence, to each of his students. At 5:00 p.m., he would walk through the laboratory asking each student what he or she had accomplished that day and making suggestions for the next stage of their research. Students often had to work late into the night to produce results by the next morning. He often remarked to a student, "This research will not win you the Nobel Prize, but it will be a good contribution to science." The cumulative work of his research group resulted in an immense gain in the understanding of properties of alloy phases.

Although Paul required that his students perform at a very high level, he was a compassionate person. After the ill-fated 1956 Hungarian revolution, the University of Illinois offered a three-month English course for a dozen Hungarian college-bound refugees. Upon completion of the course, Professor Beck unselfishly helped these students move on or find positions at the university. He wrote letters on their behalf to appropriate agencies and personally accompanied some of them to make it easier for them to get part-time jobs. He offered valuable advice to all who asked and often was translator, chauffeur, and spokesman for those in need. At times he also helped out with much needed cash.

One of these students, Denes Bardos, remarked, "He took a great risk in offering me a lab assistant job in his renowned research lab on campus, because at that time I was a music student. I worked very hard so as not to disappoint the hard-driving professor and took his advice and switched over to metallurgy. He became my faculty advisor, mentor (or should I say tormentor), all the way to the completion of my Ph.D. I could not have done it without his constant support and encouragement."

Professor Beck's major contribution to metal physics involved the determination of the density of electronic states across the 3d transition metal series. Such information requires measurements of specific heat at low temperatures where the specific heat is linear with temperature. These very difficult experiments required measurements of alloys at closely spaced e/a (electron/atom ratio) intervals all across the 3d transition metal series.

C. T. Wei and C. H. Cheng, two excellent researchers working with Paul during this period, worked closely with his students, and his group made more low-temperature, specific-heat measurements than all of the physicists in the world had made to that time. Paul's research evolved into studies of the magnetic characteristics of alloys and compounds—ferromagnetism, paramagnetism, superparamagnetism, mictomagnetism, and other effects.

Paul Beck won many awards and honors for his work. He was a fellow of the Minerals, Metals and Materials Society (TMS), American Society for Metals (ASM), and American Physical Society. In 1952, he won the Mathewson Gold Medal for one of his papers on recrystallization. He was Annual Lecturer of the Metallurgical Society of The American Institute of Mining, Metallurgical and Petroleum Engineers (AIME) in 1971. He received the Hume-Rothery Award from TMS in 1974 and the Albert Sauveur Award from ASM in 1976. In 1979, he received the Heyn Memorial Award from the German Metallurgical Society and an honorary degree from Montanuniversitaet Leoben.

In 1978–1979, Paul worked in Munich and Berlin, after receiving a Humboldt Senior Scientist Award. In 1991, he received an Honorary Degree of Doctor of Science from the University of Illinois, a rare honor, particularly for a faculty member. During Paul's professional career he served on numerous committees for the Institute of Metals Division of AIME, The American Society for Metals and the American Society for Testing Materials. During his career, he published more than 170 technical papers in scientific journals.

As a young academic, Paul often visited the laboratory of Cyril Stanley Smith, director of the Institute for the Study of Metals at the University of Chicago. On one of these visits, he met Lillian who was working in the laboratory. The couple later married and had two sons, Paul John Beck and Philip Odon Beck. Paul is survived by both sons and five grandchildren.

Gary L. Borman

GARY L. BORMAN

1932–2005

Elected in 1990

"For pioneering analytical simulation of internal combustion engines and verification with advanced experimental techniques.

BY DAVID E. FOSTER
SUBMITTED BY THE NAE HOME SECRETARY

GARY LEE BORMAN, Emeritus Professor of Mechanical Engineering, University of Wisconsin-Madison (UW-Madison), passed away on January 17, 2005, after a courageous battle with cancer. He was born in Wauwatosa, Wisconsin, on March 15, 1932. He was the only child of Meta Singer and Louis Borman. He graduated from West Allis High School and continued his education at UW-Madison in mathematics (B.S., 1954; M.S., 1956) and mechanical engineering (M.S., 1957) where his thesis was on droplet vaporization. In 1971 he married Marlene Mehls in Chippewa Falls. He is survived by Marlene and cousins in the Milwaukee area.

After graduating from UW-Madison and spending a semester teaching math at UW-Milwaukee, Borman joined General Electric Co. in Cincinnati, Ohio. His work involved rocket heat transfer and electric propulsion research for space applications. After three years at GE he gained the title "Senior Engineer." Then, when Professor Phil Myers contacted Gary about becoming an instructor in mechanical engineering to teach engineering analysis and pursue a Ph.D., he chose to return to academia. Borman's 1964 Ph.D. thesis was titled "Mathematical Simulation of IC Engine Processes and Performance."

Professor Borman's research concentrations included the internal- combustion engine, lubrication, spray vaporization, and cycle analysis. His keen intellect, coupled with a strong analytical background, gave him insight into the processes occurring in the engine and propelled him to the pinnacle of his field. He was acclaimed for activities in engine modeling as well as for fundamental experiments. His pioneering work in thermodynamic analysis of engines led to an analysis technique known as heat-release analysis. This analysis procedure has been adopted by every internal combustion engine manufacturer in the world. It is now a standard component of every engine data analysis package sold today. His insight into the thermophysical processes within the engine resulted in novel measurements of temporally and spatially resolved heat flux within the cylinder, oil film thickness measurements between the piston rings and the liner of a firing engine, and integrated time-resolved, in-cylinder nitrogen oxide measurements of an operating diesel engine. This latter work was recognized by the Society of Automotive Engineers (SAE) with the Horning Memorial Award, an award for the best technical paper of the year in the area of combustion and fuels.

Professor Borman was dedicated to his profession as an educator and a public servant to the university and the technical community. He co-authored a graduate level textbook, *Combustion Engineering*, with Professor Ken Ragland. He regularly taught heat transfer, thermodynamics, and combustion.

Working with Professors Phil Myers and Otto Uyehara, he helped the engine research program at the university grow from a collection of individual faculty with research contracts into the internationally recognized Engine Research Center. He served as its first director from 1986 to his retirement in 1994. Professor Borman advised 40 master of science mechanical engineering, and 21 Ph.D. students.

He was a fellow of the Society of Automotive Engineers (SAE) and served on the Board of Directors of SAE. In 1965, he received the SAE Ralph R. Teetor Award, in 1966 the SAE Arch T. Colwell Merit Award, and in 1978 the SAE Harry L. Horning Memorial Award. He was elected to the National Academy of Engineering in 1990 “for pioneering analytical simulation of internal combustion engines and verification with advanced experimental techniques.”

Gary had a keen interest in gardening. He and his wife Marlene always landscaped their home garden personally and kept it in excellent shape. He traveled throughout his career and after retirement traveled for personal pleasure with Marlene. They went to Europe, England, Spain, Switzerland, Yugoslavia, Egypt, Japan, and the Scandinavian countries, and they traveled extensively in the United States. Their interests were in seeing the gardens, parks, and museums of each country. Gary kept up an active interest in history, economics, and current affairs and was an avid photographer. In addition, he was a fine cook and entertained friends regularly at his home.

His impact on the internal combustion engine community, his colleagues at the university, his students, and his many friends was immeasurable. His spirit lives on in all who knew and worked with him.


Joseph E Burke

JOSEPH E. BURKE

1914–2000

Elected in 1976

"For contributions and administration of research and development in ceramics."

BY R. NED LANDON AND JACK H. WESTBROOK

DR. JOSEPH E. BURKE, a key innovator in the "science of ceramic materials" died in Schenectady, New York, on February 29, 2000. Joe's remarkable life began in Berkeley, California, where he was born on September 1, 1914, to Charles Eldrid and Ruth Enid (Hancock) Burke. He lived his early years in Canada and was a 1938 graduate of McMaster University. He received his doctorate in ceramic science from Cornell University and worked for the International Nickel Company and the Norton Company until being handpicked in 1943 to join the world-famous Oppenheimer-led Manhattan Project team at Los Alamos.

During World War II, 1943–1946, Dr. Burke worked at the Los Alamos, New Mexico, National Laboratory, where he helped design, build, and manage the first large-scale facility for the preparation of plutonium nitrate and its conversion to bomb cores. Dr. Burke's contributions to the development of the first atomic weapon were eventually detailed in "Recollections of Wartime Los Alamos: Uranium Hydride Preparation and Plutonium Processing" (*Journal of Nuclear Materials*, volume 100, November 16, 1981).

When wartime restrictions were later eased, Joe and his wife, Mary, collaborated on a fascinating report of life in Los Alamos, including Mary's role in the birth and upbringing of the Burke children and her development of longtime friendships with key scientists of the Manhattan Project and their wives. (Mary triumphed over Mrs. Hans Bethe in securing a prized Los Alamos apartment just in time for an addition to the Burke family. This was while Joe's reputation for expertise in the development and processing of uranium-based ceramic materials was growing rapidly and steadily among members of the Los Alamos Manhattan Project's technical community.)

Together with his wife Mary, Joe also wrote and published "Recollections of Wartime Los Alamos" (August 1995), a booklet that has since become "favorite and absolutely fascinating reading" for countless friends and former associates. (Contact the NAE Membership Office for a copy of the booklet.)

In a separate paper, Joe said: "Finally plutonium (being produced at Hanford) was introduced at our plant, and the processes operated without a hitch. One difficulty was encountered, however; our plutonium assay did not agree with the amount Hanford said they were shipping to us. I was most grateful for a good accountability system, and we merely kept two sets of books until the difficulty was straightened out nearly six months later. The cause of the discrepancy was that during shipping a very insoluble precipitate formed in each shipping canister, and we were simply not getting out all the plutonium which had been shipped. . . . Once our laboratory-plant was fully operational, we had many visitors. One of the first was Robert Oppenheimer. Since he was a physicist, I did not expect him to understand these chemical and metallurgical operations very well, but he asked good questions. . . . A couple of weeks later he brought David Lilienthal of TVA out to see the new installation and we prepared ourselves to show the pair through our lab. However, Oppenheimer himself took Lilienthal around the whole place, describing it in at least as much detail as we had presented him. He certainly had a fabulous capacity for absorbing information."

Joe's memories of Los Alamos included his great admiration for the talents and dedication of the technical team that had been assembled there; the "almost universal" agreement that the job they were doing was "patriotic and the right thing to do"; and, finally, an absolutely intriguing description of the famous Trinity Test in Alamagordo, New Mexico, on July 16, 1945. (Japan surrendered 45 days later, on September 1, 1945.)

After the war, Dr. Burke became a faculty member at the Institute for the Study of Metals at the University of Chicago, where he worked on the origins of microstructure in metals and the kinetics of grain growth. (In a note to the Alumni Office, he later wrote, "Through the golden years of Metals Science, I was a *metallurgist*. . . . I now usually call myself a *ceramist* or *materials scientist*.")

In 1949 he joined the Knolls Atomic Power Laboratory (KAPL), operated by General Electric for the Atomic Energy Commission in Schenectady, first as a research associate, later as manager of metallurgy. At KAPL Joe was responsible for directing a remarkably successful group of metallurgical and ceramic scientists, but subsequently—after the arrival of a new KAPL director, famous for his insistence on "real engineering" as opposed to "non-pertinent" science—Joe and several other new and longtime associates at KAPL were convinced in 1954 to "move up the hill" to Niskayuna, New York, to what by then was the General Electric Research and Development Laboratory—and is now GE's Global Research Center.

Joe soon formed a new group to develop "advanced ceramics." His research teams made many fundamental contributions to the understanding of this new class of materials; observed and interpreted the microstructure of ceramics on polished surfaces; and invented "Lucalox," a pore-free alumina, making possible the high-pressure sodium lamps that now dominate much of the world's lighting products. They also made important progress on the processing of uranium oxide for nuclear fuel and made many advanced ceramics for electronic and electrical purposes.

From 1972 to 1979, Dr. Burke had assignments in program planning and other special activities at the GE R&D Center. Later he resigned to become a consultant in materials science and engineering. He also served as adjunct professor of ceramics at Rensselaer Polytechnic Institute in Troy, New York, and as a consultant to GE, the Cabot Corporation, the

Gillette Company, TPV Energy Systems, Ind., and several other organizations.

The principal speaker at Joe's retirement dinner in May 1979 was Dr. Roland W. Schmitt, GE vice president and director of the GE R&D Center. He had succeeded Drs. Willis R. Whitney, William D. Coolidge, C. Guy Suits, and Arthur M. Bueche as GE's research director and top technical officer. Dr. Schmitt promptly demonstrated the sense of humor that proved so useful in his subsequent position as president of Rensselaer Polytechnic Institute.

Dr. Schmitt: "I remember back in 1954, when I was a physicist working at the bench in the Metallurgy and Ceramics Lab of the Research Laboratory that a metallurgist named Joe Burke joined our organization. Within a month, Herb Hollomon had asked him to form a new Ceramics group. Now you might ask the question that Joe himself has asked in one of his papers, 'Why should a metallurgist look at ceramics?' Well, the answer was, of course, that we solid-state physicists had already solved all the problems of metallurgy, so Herb had to find *something* for the metallurgists to do. But, more seriously, there was a tremendous opportunity to take the remarkable advances in metallurgy in the preceding decades and apply them to ceramics. This was just the charter that Herb Hollomon gave Joe Burke. Ceramics clearly played a large role in the life of an electrical manufacturing company. Metallurgists had developed exciting new tools for examining and understanding materials. There was high optimism that when these tools were applied to ceramics, great things would result. Well, thanks to Joe Burke and his colleagues, the optimists were proven right. Ceramics *have* scored a number of outstanding successes in such fields as dielectrics, glasses, cutting tools, optical materials, and graphites. But tonight we'd like to concentrate on one area in particular—a story that turned out to be exciting, beautiful, and 'illuminating' for Joe Burke, for General Electric, and for the world."

There were additional comments (and compliments) about the evening's guest-of-honor retiree, Dr. Joseph E. Burke: "We have spoken about 'new tools' for a 'new look' at ceramics.

Well, Joe didn't forget how to also make good use of the 'old tools'—his eyes—and his microscope. To many of us, what he was looking at would have seemed just like some complicated mess. But to Joe's trained eye, it was a significant, complicated—and highly useful—mess. The significance was in small regions that were just a little clearer than their surroundings. That told Joe that if you took powder grains of alumina ceramic, pressed them together, and then heated them up, you could observe very small regions that were transparent. Well, not transparent exactly, but a least translucent. The thought then popped into Joe's mind: 'If you could do this in very small regions, why couldn't you do it over the whole piece? And if you did that, then maybe—just maybe—you would have the material the GE Lamp Division needed for a whole new line of remarkable electric lamps.'"

Also heard during the evening: "We can't guarantee that Joe used those exact words—but within three years, that's exactly what happened. A young scientist Joe hired from MIT, Bob Coble, went to work and discovered procedures that, for the first time, resulted in optical-grade polycrystalline alumina. A new material was born—and it needed a new name. The word 'lucid'—meaning 'clear'— was put together with the suffix 'alox'—meaning 'aluminum oxide'—to form the word 'loose-alox.' But somehow that pronunciation never caught on. Perhaps it sounded too much like a laxative. What many rate as ceramic science's greatest gift to the lamp industry has gone through life mispronounced 'luke-a-lox' by millions of satisfied customers."

Comments about the guest of honor continued: "Thus, in short, Dr. Burke and his associate not only produced what was often called 'bendable pottery' but had even shown new ways to make it *light transmitting* and even *optically transparent*, as well as readily formed and suitable for many, *many* industrial applications. The result of this long and intensive laboratory effort—Lucalox—was licensed and sold for many uses by General Electric but soon became of special interest to GE's Lamp Division, where Lucalox lamps have had a very extensive impact on the world's lighting business—and the conservation of energy. The key patents, developed and secured under Joe Burke's leadership, do not bear his name as one of the inventors, although as his associates invariably say, 'Joe was the key inventor; he just had a modest policy of not wishing to detract any credit from the scientists who worked for him.' "

Dr. Schmitt himself concluded Joe Burke's retirement dinner with these carefully selected words: "I want to add that Dr. Joseph E. Burke has also always been an invaluable inspiration and guide to a generation of industrial researchers. His career stands as a model of the type of contribution that can be made by a single individual who brings to his job not only skills and knowledge but also optimism, enthusiasm, and wisdom. In my years at the R&D Center, I can recall no individual who embodied those qualities more completely than Joe Burke."

Dr. Burke was elected to the National Academy of Engineering in 1976. He had been active in the American Ceramic Society (ACS), of which he was a fellow, for many years, and was made a distinguished lecturer in 1972, president in 1974, and a distinguished life member from 1982. From the ACS, he received the John Jeppson Medal in 1981 and the W. David Kingery Award in 1999. He also was a fellow of the American Nuclear Society and the American Society for Metals (ASM) and a member of the British Ceramic Society and the American Association for the Advancement of Science. He also was a fellow of the American Nuclear Society and ASM International. Results of his work are documented in six patents and more than 40 technical papers. He was co-author, with A. U. Seybolt, of the book *Procedures in Experimental Metallurgy* (Wiley, 1953) and co-editor, with D. W. White, of *The Metal Beryllium* (American Society of Metals, 1955). He also served as editor of a review series, "Progress in Ceramic Science."

Joseph E. Burke, by his gentle, likeable, and modest nature, would never have approved of any efforts by friends to describe themselves as members of "the greatest generation." But his co-workers, cognizant of his truly remarkable career—from key contributions at Los Alamos leading to the end of World War II, to his return to teaching at the University of

Chicago, to his managerial leadership at the Knolls Atomic Power Laboratory, to his subsequent reputation at the General Electric Research Laboratory as a key innovator in the "science of ceramic materials" that led to one of the most important revolutions in electric lighting since Thomas Edison's original invention—surely his friends would have been quick and proud to agree about Joe Burke's greatness.

Was he truly part of the greatest generation? Joe could have reluctantly admitted that "perhaps we *might* have been." But his friends and associates would have insisted that theirs indeed was the greatest generation, while emphasizing the significant contributions of both Joe and Mary Burke.

Joe's survivors include his second wife, Marjorie Ridgway Burke, of Eskaton Village in Carmichael, California; his son Charles Robert Burke of Concord, Massachusetts; his daughter Margaret ("Molly") Burke VanDecar of Guilderland, New York; and four grandchildren. Kathleen Mary Wilson, his first wife, died in 1996.

SPENCER H. BUSH

1920–2005

Elected in 1970

"For contributions in the physical and mechanical metallurgy of materials used in nuclear reactors."

BY JUDITH GRAYBEAL
SUBMITTED BY THE NAE HOME SECRETARY

SPENCER BUSH, an international authority on nuclear metallurgy and a driving force in the development of nuclear power codes and standards, passed away on October 2, 2005, in Richland, Washington, at the age of 85. He was elected to NAE in 1970 "for contributions in the physical and mechanical metallurgy of materials used in nuclear reactors."

On July 12, l945, a U.S. Army corporal drove an inconspicuous sedan to an old adobe ranch house on what is now the White Sands Missile Range. His cargo was the plutonium core of the "gadget," the world's first nuclear device. When it was detonated four days later in the Trinity test, it not only changed the world, it also set the direction of the young man's life. Spencer Harrison Bush devoted more than 50 years to advancing knowledge of the physical and mechanical metallurgy of nuclear materials and to ensuring the safety of nuclear reactors.

Spence Bush was born on Easter Sunday, April 4, 1920, in Flint, Michigan. After attending high school and junior college in Flint, he worked as an assistant chemist at Dow Chemical Company in nearby Midland, Michigan, until he left to serve in the Army from 1942 to 1946. He spent the last years of the war in the Special Engineering Detachment assigned to the Manhattan Project at Los Alamos, New Mexico.

After the war, Spence enrolled at the University of Michigan, where he earned bachelor's degrees in metallurgical and chemical engineering in 1948, a master's degree in 1950, and a doctorate in chemical engineering in 1953. During that time he also launched a publishing career that eventually included more than 100 journal articles, as well as book chapters, formal reports, and one book.

In 1953, he went to work at the Hanford Site near Richland, Washington. Reactors at Hanford produced the plutonium for the Trinity test, the Nagasaki bomb, and, later, for the nation's Cold War arsenal. Bush transferred to Pacific Northwest National Laboratory (PNNL) in 1965, when the U.S. Department of Energy spun off the laboratory from Hanford and widened its research base. Although he retired in 1983 to establish his own firm, Review & Synthesis Associates, Spence said he "could not imagine not being involved in some way with the nuclear power industry." He continued as a consultant to the laboratory and others in government and industry worldwide until his death.

Spence was a registered professional engineer whose areas of research included failure mechanisms in pressurized nuclear reactor systems, stress corrosion in piping and turbines, effects of radiation damage on material properties and component design, and seismic design of pressure-boundary components. His early work centered on the effects of radiation on materials used in reactor fuel and reactor fabrication, particularly metallic uranium, zirconium, austenitic stainless steels, and pressure-vessel steels. He directed fundamental studies on irradiation damage of fissile and non-fissile metals and supervised the development of fabrication processes for nuclear fuels and structural components. Several of those processes were used for many years in the production of nuclear components.

"It was a whole new field back then," said PNNL colleague Burt Johnson. "The impacts of radiation on corrosion environments were not well understood, and there was a fascination to see the effects and how they applied to the specification of materials."

Spence soon broadened his interests to include the reliability and failures of piping for nuclear power plants, reactor pressure vessels, and related systems. His work on stress corrosion and failure mechanisms was acclaimed in the nuclear community. He pioneered the development of non-destructive inspection technologies and risk-based in-service inspection standards, as well as the development of rules for flaw evaluation that provide a basis for rational decisions about whether nuclear power plants can operate safely. Bush also was instrumental in the evaluation of flexibility analysis rules for piping systems to ensure reliability while reducing maintenance costs.

Highly regarded by his peers in the nuclear power community, Bush represented the United States in the International Atomic Energy Agency's effort to develop international in-service inspection standards and was a key member of several European and Japanese programs for the inspection of steel components. He chaired or served on numerous U.S. Nuclear Regulatory Commission committees, including the Advisory Committee on Reactor Safeguards. He also chaired the Welding Research Council's Pressure Vessel Research Council steering committee on the design of nuclear piping systems and the Pressure Vessel Study Group of the Electric Power Research Institute.

Spence was extremely active in the American Society of Mechanical Engineers (ASME). He played an essential role in the development of the ASME Boiler and Pressure Vessel Code Section XI: Rules for In-service Inspection of Nuclear Power Plant Components, which established criteria for the pre-service and in-service examination of nuclear power plants. Spence led the development of the analytical methods in Section XI for evaluating flaws identified by in-service inspections. Section XI was then expanded to include methods of repairing unacceptable flaws.

Section XI requires that all operating nuclear plants meet standards that ensure safe and reliable operation, requirements that were formally accepted by the Nuclear Regulatory Commission. Owen Hedden, a colleague, noted that, with Bush's guidance and encouragement, nuclear power plant operators worldwide accepted or adapted the Section XI rules.

ASME recognized Bush's achievements in a memorial symposium during a conference in July 2007. In describing Spence's contributions to risk-informed in-service inspection technology, Kenneth Balkey of Westinghouse Electric and Fredric Simonen of PNNL wrote that Bush "spent two decades guiding ASME research efforts for this technology and then supporting the writing of Code requirements to implement programs in the United States and throughout the world."

In another presentation, Martin Prager of the Pressure Vessel Research Council remembered Bush as an energetic and creative synthesizer of technology into effective practices. "Spence was a consensus builder by virtue of his knowledge, judgment, personality and professionalism. We called on him for many challenges, and he never said no to an assignment," Prager said. "If there was a steering committee to be established, his name was always first on the list. Subjects as diverse as failure modes, NDE [non-destructive examination], piping design, seismic effects, corrosion fatigue, risk-based inspection, and other aspects of risk analysis were all in his sphere of expertise. His counsel was wise and his judgment practical, unbiased, objective and defensible."

For these and many other achievements, Spencer Bush was elected to the National Academy of Engineering in 1970. Other honors included fellow of the American Nuclear Society (ANS), the American Society for Metals (now ASM International), and the American Society of Mechanical Engineers (now ASME International); ASME Gillette Lecturer and Mehl Lecturer for the American Society for Nondestructive Testing; senior member of American Institute of Mining, Metallurgical and Petroleum Engineers; recipient of the ANS T.J. Thompson Award and the ASME Bernard Langer Nuclear Codes and Standards Award and Melvin R. Green Codes and Standards Medal; and member of Sigma Xi, Tau Beta Pi, and Phi Kappa Phi.

Colleagues called Bush a walking database who could instantly read—and remember—vast amounts of information and could "synthesize a recommendation out of apparent chaos." His vast library filled several rooms in the basement below his office. When attending conferences, he came "loaded with so much documentation that his briefcase caused him to walk with a list."

Despite traveling as many as 200 days a year, Spence always made time to assist and encourage junior staff. He instilled the importance of publishing in his young colleagues and chaired or served on numerous professional society honors and awards committees. He was an affiliate or adjunct professor of metallurgical engineering at the Joint Center for Graduate Study of the University of Washington, Washington State University, and the University of Oregon, as well as a Regents Professor at the University of California, Berkeley.

On the personal side, Spencer Bush and Roberta (Bert) L. Warren, whom he married in 1948, had two sons, David Spencer, born in 1949, and Carl Edward, born in 1957. Bert was a librarian at the Hanford Site for many years and frequently assisted Spence in obtaining the masses of documents on which he thrived.

A favorite memory of son Carl is his dad's speed reading and photographic memory. Spence would consume several science fiction novels in a day. He devoured James Michener's *Hawaii* in an afternoon and later amazed his carpool by quoting entire passages, complete with page numbers.

Spence was a gourmet cook, a wine connoisseur, and an early aficionado of Eastern Washington vintages. He loved salmon-fishing weekends at Fuzzy Joe's Campground on the Pacific coast and hunting doves in the Horse Heaven Hills with his Weimaraner, Bonnie. Spence was president of the

Blue Mountain Council of the Boy Scouts of America, which covered southeastern Washington and all of eastern Oregon. He received the Scouts' Silver Beaver Award for that service, an honor of which he was particularly proud.

His daughter-in-law remembers that:

> When Spence was not working, he would take his young family fishing and sailing, and as the boys grew older he often took them bird hunting. He enjoyed being outdoors, and weather permitting, could often be found in the garden tending to the many fruit trees, raspberry bushes, vegetables, and perennials in the yard.
>
> Spence enjoyed fine foods and wines, and his wealth of knowledge on the subjects was impressive. On one particular occasion he unknowingly educated a bystander at a cheese counter as he and his wife Bert discussed the merits of a particular cheese and where in Europe they had first encountered it. He was content in the kitchen working alongside Bert, trying out new recipes to go with that perfect bottle of wine. Over the years, when he visited family, he would show up with a grocery list of items to be obtained at gourmet food and wine shops, and always had a list of restaurants in the area he wanted to try.

"Spence was more than a genius," said friend and collaborator Larry Chockie. "There are a lot of geniuses. But when an individual exceeds the definition of genius, that person is called a phenomenon, and a phenomenon comes along only once in a lifetime. That was Spence—he was a phenomenon."

ACKNOWLEDGMENTS

The author thanks Alan B. Carr, historian, Los Alamos National Laboratory, for his assistance in researching Spencer Bush's experience during the Manhattan Project and ASME International for permission to quote from the proceedings of "Recent Advances in NDE and ASME B&PV Section XI—A Memorial Symposium in Honor of Dr. Spencer H. Bush, July 22-26, 2007."

L. G. (GARY) BYRD

1923–2009

Elected in 1987

"For pioneering contributions to highway maintenance management systems and research"

BY FRED N. FINN
(WITH CONTRIBUTIONS FROM HIS SONS GARY AND JEFF BYRD)

GARY BYRD, a leader among leaders in his chosen profession as a civil engineer, died March 20, 2009, in Tryon, North Carolina, at the age of 85. He was born in Atlanta, Georgia, on May 6, 1923, the son of Lloyd Porter and Gladys Ardee (Daniell) Byrd. He received his B.S. in civil engineering from the Ohio State University in 1950, following time spent at the University of Michigan in 1944–45. In 1978 Gary was honored by his alma mater with its College of Engineering Distinguished Alumnus Award.

His early professional experience began in 1949 at the Ohio State Highway Department. In 1956 he moved to the Ohio Turnpike Authorities serving as its maintenance engineer until 1960. That year he moved to Ridgewood, New Jersey, to become associate editor at Public Works Publications. In 1963 he formed a partnership with Bertrum D. Tallamy, who had been the Federal Highway Administrator in the Eisenhower administration. He later formed the firm of Byrd, Tallamy, MacDonald and Lewis, which became a division of Wilbur Smith and Associates in 1972.

As senior vice president and director of Wilbur Smith and Associates, Byrd was principal-in-charge of major design projects for the Washington, D.C. Metropolitan Area Transit Authority, as well as for departments of transportation in Virginia, Illinois, New York, Pennsylvania, and Maryland. He led management systems studies covering highway operations, maintenance, and equipment fleets for transportation agencies in Idaho, Nevada, Montana, Colorado, Ohio, Illinois, New York, New Jersey, Massachusetts, and overseas in Bolivia and Jordan. He also led the inspection and evaluation of rehabilitation requirements for highway bridges in Virginia, Illinois, New York, North Carolina, and Pennsylvania.

After his retirement from Wilbur Smith and Associates in 1984 until his death in 2009, Byrd consulted with government agencies (state, federal, and international), and with many U.S. and international companies. During his career, lasting over 30 years, he also wrote volumes of reports, and papers for technical journals covering all aspects of highway operations and maintenance. He was the editor of the *Street and Highway Maintenance Manual* (American Public Works Association, 1985) and the *Handbook of Highway Engineering* (Van Nostrand Reinhold, New York, 1975). By the end of his career Gary was an internationally recognized expert and consultant in his chosen field.

This author remembers first becoming familiar with the name Gary Byrd in the late 1970s through his activities with the Transportation Research Board (TRB) of the National Academies and his publications which described efficient and cost-saving programs for agency oversight of highway networks. During those years when Gary was studying and publishing about highway maintenance, I was helping to develop better processes for pavement management. I often turned to his Handbook and journal publications as resources. Gary pioneered the idea of using systems engineering as a basis for "maximizing benefits and minimizing costs" when managing resources for the design and maintenance of a highway network.

From 1984 to 1986, Gary served as director of the American Association of State Highway and Transportation Officials (AASHTO) Strategic Highway Research Program (SHRP), and I was selected to chair a committee of experts—from state governments, private industry, and academia—to outline that portion of the $150 million research program dealing with the use of asphalt and asphaltic mixtures for pavements. The proposed asphalt research program had similar goals to those Gary had been proposing for highway network maintenance (e.g., improved performance and reduced life-cycle costs). In his role as overall director of the research program, I and the other members of the committee would frequently call on Gary for advice and guidance. He was always available and helpful.

How best to conduct research on virgin asphalt was a controversial topic at the time. Some members of our committee supported a basic, more fundamental approach while others supported a more empirical approach. Ultimately the decision came down to a series of negotiations between the committee and the AASHTO directors. Gary played a key role in shaping an acceptable and productive program and the results of the SHRP asphalt research program will certainly remain as one of his major legacies. Many of that program's findings are still being used throughout the highway industry.

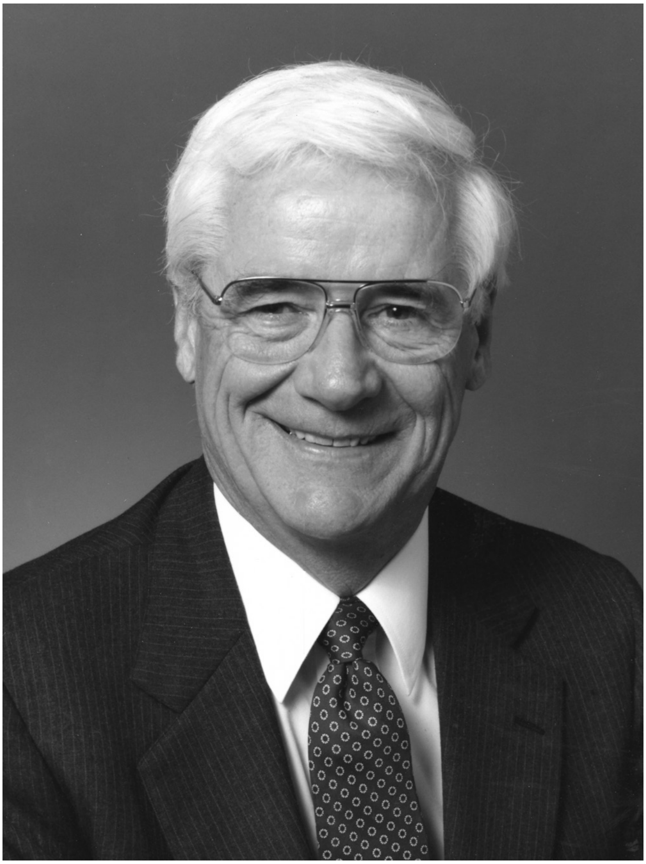
However, Gary's contributions to the improvement of highway maintenance programs and his leadership role in the SHRP asphalt research program, while very important, are only part of his legacy. Gary's subsequent policy guidance consulting contributions to the American Society of Engineers and to the National Academies (on the Transportation Research Board, the National Academy of Engineering, and the National Research Council) added significantly to his legacy.

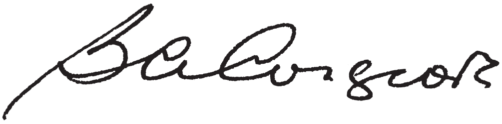
Gary served on Transportation Research Board committees from 1975 through 1995 and was awarded the boards Roy W. Crum Distinguished Service Award in 1986. He was inducted into the National Academy of Engineering in 1987 "for pioneering contributions to highway maintenance systems and research." He served as a member of the Governing Board of the National Research Council from 1989 to 1995. He was also an active member of the American Association of Engineering Societies, the American Society of Civil Engineers, and the American Public Works Association.

Gary was also very active in civic life, serving as the chairman of the Fairfax County (Virginia) Human Rights Commission from 1978 to 1979, president of the Fairfax County Chamber of Commerce from 1975 to 1976, and as a member of the Hospice of the Carolina Foothills (North Carolina) board of directors from 2002 to 2007. He was a member of the Tryon Country Club (North Carolina), the Rotary Club of Tryon, and the Congregational Church in Tryon.

He is survived by his wife of 66 years, Jeanne Mae (Parkhurst) Byrd; two daughters, Donna Van Ness (David) of Monument, Colorado, and Julie Burke of Tryon; two sons, Gary Byrd of Buffalo, New York, and Jeff Byrd (Helen) of Tryon; three brothers, C. Daniell Byrd of Houston, Texas, Richard Byrd (Janine) of Downers Grove, Illinois, and Robert Byrd of Columbus, Ohio. Also surviving are ten grandchildren, Matthew, Amy, Greg, Adam, Emily, Katie, David, Sarah, Daniel, and Colleen and six great grandchildren, Thomas, Finn, Olivia, Aspen, Brooklyn, and Ella.

It was an honor to have had this opportunity to add to this tribute to the life and work of L. G. (Gary) Byrd. This tribute comes from a colleague who knew and worked with him personally for only a few years, but who was influenced by him professionally throughout his career.





BENJAMIN A. COSGROVE

1927–2006

Elected in 1992

"For contributions to the development and design of commercial jet transport aircraft"

BY JOHN WARNER AND PHIL CONDIT

BEN COSGROVE, major contributor to airline safety and a longtime Boeing engineering leader, died September 8, 2006. His contributions to the knowledge of aging aircraft and the techniques to ensure their integrity were groundbreaking.

Born in 1926 in Detroit, Michigan, Cosgrove played with model airplanes as a child—thus began a lifelong fascination with airplanes. After a stint in the Navy, he entered Notre Dame University and earned a B.S. in aeronautical engineering. He received the College of Engineering's Honor Award in 1985 in recognition of his distinguished achievements in engineering, management, and service to the field of aviation. He received an honorary doctoral degree in engineering from Notre Dame in 1993.

Cosgrove's career began at the Boeing Corporation in 1949, when he helped design the tail assemblies for the B-47. During his career he was associated with almost all of Boeing's jet aircraft programs. He served as a stress engineer and structural unit chief on the B-47, the B-52, and the KC-135 tanker. For the 707, he worked on the fuselage design; for the 727, he helped design the wings; for the 737, he dealt with stress issues; and for the 747, he was unit stress chief. He also worked on the U.S. supersonic transport program. In 1973 he became chief project engineer for the 707 and in 1976 was appointed director of engineering for the 707/727/737 division. This experience, particularly involving structures, won him a worldwide reputation.

Cosgrove was later promoted to chief project engineer and director of engineering for the 767 program. In June 1983 he was appointed director of engineering for the Everett Division (747/767 programs). The 767 had many innovations, such as the glass cockpit, and he was instrumental in making that program a success.

The veteran engineer was appointed vice president and general manager of the Engineering Division of Boeing Commercial Airplane Group in 1985. During this time, Cosgrove provided engineering staffing and oversaw technological progress on the 777. He paid close attention to and supported the first widespread use of computer-aided design for a commercial airplane.

In May 1989, Cosgrove was promoted to senior vice president. He also assumed the government affairs post, responsible for all liaison with regulatory agencies in matters of design and technology, and he was the senior executive on safety matters. Cosgrove retired in 1993.

Cosgrove was a member of the Aging Fleet Task Force, formed in 1988 after a structural failure in the fuselage of an aging Aloha Airlines 737. His integrity, technical knowledge of structures, and reputation helped convince airline leaders to replace parts on airplanes once they reached a certain age. According to one member of the task force, Cosgrove was able to speak his mind without hesitation—and airline presidents listened.

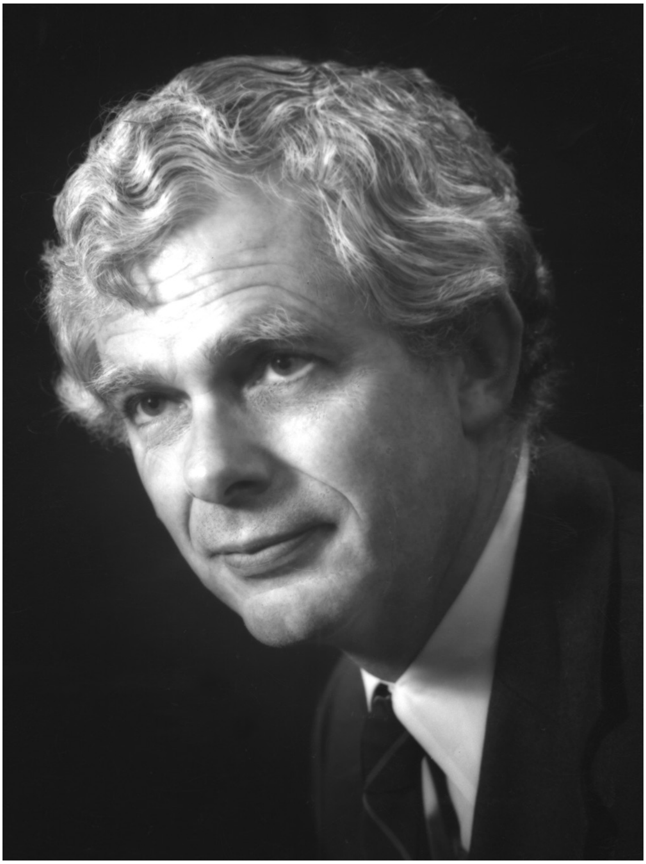
Cosgrove was honored by the National Aeronautical Association in 1991 with its Wright Brothers Memorial Trophy for lifetime contributions to commercial aviation, safety, and technical achievement. In 1992 he was inducted as a member of the National Academy of Engineering for his contributions to the development and design of commercial jet aircraft. He subsequently served on nine different committees for the Academy.

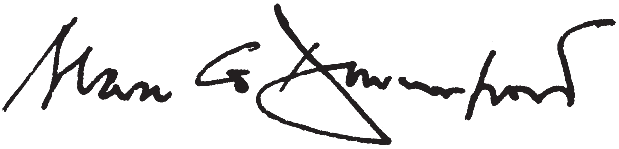
Cosgrove was honored in 1983 by the Society of Aviation and Space Technology for his role in converting the Boeing 767 transport design from a three-man to a two-man cockpit configuration. In 1988 he received the Collier Award for significant contributions to aviation propulsion technology. And in 1988 the Society of Automotive Engineers awarded him the prestigious Franklin W. Kolk Award for development of the technologies used in the current family of airplanes. In 1989 the American Institute of Aeronautics and Astronautics (AIAA) awarded him the Ed Wells Technical Management Award for his efforts in addressing issues related to aging aircraft. In 1991 he received the annual Design News Magazine Special Achievement Award for his contributions to the industry.

Cosgrove was a member of the Society of Automotive Engineers Aerospace Council, the Daniel Guggenheim Medal Board, and the American Society of Mechanical Engineers Industry Advisory Board and was a fellow of both the AIAA and the Royal Aeronautical Society.

Benjamin Cosgrove was a legend both in the industry and at Boeing. He expected a great deal from his people, and his colleagues, and he motivated and inspired many an engineer. He was a structures guy through and through, and he never let anyone forget that structural design is the backbone of a successful airplane. He insisted on integrity and ethical behavior from his employees. He also worried about overdependence on computers. He instilled in all engineers the notion that understanding must be grounded in fundamentals and engineering principles and that good judgment was always the guide. His advice was: “Hold your fire until you know your business.”

Cosgrove is survived by his wife, Virginia, and five children.





ALAN G. DAVENPORT

1932–2009

Elected in 1987

"For pioneering contributions to the design of wind-sensitive structures, description of the urban wind climate, and wind tunnel testing of structures."

BY LESLIE EARL ROBERTSON

ALAN G. DAVENPORT, founder of the Alan G. Davenport Wind Engineering Group of the Boundary Layer Wind Tunnel Laboratory, located at the University of Western Ontario, and the inspiring genius of the broad field of wind engineering, died from complications of Parkinson's disease on July 19, 2009. He was 76.

As I set out to accomplish this writing, I knew that, no matter what flowed onto the paper, it would not be possible for me to do service to this remarkable man. Both as a fellow engineer and a friend, Alan Davenport was a very special person.

Alan was elected a foreign associate to the National Academy of Engineering in 1987. Initiated by his leadership role in wind engineering for the twin towers of the World Trade Center, Alan guided the field of wind engineering into extraordinary forward strides. His interests and his contributions, being always ahead of the rest of us, varied from the dynamic response of buildings and bridges in turbulent wind to the possible wind-induced destruction of whole countries in the Caribbean and on to such fields as the movement of sand in the desert. There was no limit to his interest in and his contributions to the effects of wind on the built and the nonbuilt environments. In short, throughout his life, Dr. Davenport was the guiding light in the field of wind engineering and its many associated disciplines.

Let us look back at the origins of this extraordinary engineer.

Alan was born in Chennai (Madras), India, to a family of tea farmers. His early education was in South Africa, where his talents in mathematics and science began to unfold. Then it was on to Cambridge University, where he completed both a B.A. and an M.A. in mechanical sciences. Following his love of aviation and a brief stint as a pilot in the Canadian Navy, Alan responded to his love of engineering by completing an M.A.Sc. in civil engineering at the University of Toronto.

Ms. Sheila Rand Smith—brilliant, witty, and a fellow student—became Alan's bride in 1957. They were to have four delightful children: Thomas, Andrew, Anna, and Clare. Before the children, Alan and Sheila had returned to the United Kingdom, where in 1961 he earned his Ph.D. in civil engineering from the University of Bristol. Both encouraged by Sheila and sensing the excitement and freedom of thought to be found in Canada, Alan accepted a position as associate professor at the University of Western Ontario, where, but for his brief stint in New York with us, he was to spend the remainder of his career.

In 1963 Alan became the lead wind engineering consultant for the twin towers of the World Trade Center, in New York City. At that moment in time, the rational wind engineering design of tall buildings was yet to be born. The World Trade Center was the first tall building to be tested and analyzed in the realistic environment of turbulent wind. Further, unlike the tall buildings of the past, the World Trade Center was the first that did not incorporate the stiffening and damping associated with in-filled masonry. Accordingly, unlike with all other tall buildings of that era, our design could not rely for guidance on prior experience. Indeed, Alan's work on this project provided an extraordinary step forward in the field of wind engineering. Combining the lack of prior experience in wind engineering with our new structural system required a unique combination of technical expertise, vision, genius, and communication skills. Alan was uniquely qualified to bring forth all four of these capabilities.

Standing on the shoulders of his incredible achievements with the wind engineering design of the World Trade Center, Alan convinced the University of Western Ontario that on-campus construction of a boundary layer wind tunnel would lead to significant developments in the rational design of buildings and structures and of the environments around them. The construction of the first wind tunnel led to the construction of a second. Driven by his genius, these facilities developed countless advancements in the broad field of wind engineering.

But wind tunnels alone do not create these advances. It was the brilliance and the personal skills of Alan Davenport that attracted the most talented men and women in the field to move to London, Ontario, to work with him.

Now, as you walk through these facilities, you will find memories of the past and of the present—models of some of the most famous buildings and bridges of our time. Beyond the World Trade Center, you will find the Willis (Sears) Tower of Chicago, Hong Kong's Bank of China Tower, Toronto's CN Tower, the Shanghai World Financial Center, and the fabric roof of Jeddah's Hajj Terminal—and the list goes on and on. I am told that nearly 100 bridges have been tested in Alan's laboratory—bridges being one of Alan's great loves.

Beyond the wind tunnel testing and the analyses of these wonderful structures, Alan's interests and contributions were nearly endless. He pioneered the development of Canada's first statistically based seismic zoning map, he served as chair of the AISC's Task Committee on Wind Forces, he was director of the Institute for Catastrophic Loss Reduction, and he served on countless committees in Canada, the United States, and elsewhere.

Alan was founding editor of the *Canadian Journal of Civil Engineering* and was on the editorial board of six other journals. He received honorary degrees from the Technical University of Denmark, McGill University, the University of Toronto, and the University of Western Ontario—and perhaps a half-dozen others, equally as prestigious.

A partial listing of his honors and medals is given here: the Duggan Medal and Prize, the Gzowski Medal from the Engineering Institute of Canada, the Alfred Nobel Prize from the six founding engineering societies of the United States, the Gold Medal of the Institution of Structural Engineers, and many others. In 2002, Professor Davenport received Canada's most prestigious honor for lifetime achievement when he was appointed a member of the Order of Canada.

While Professor Davenport published over 200 significant papers, his trend-setting paper, "The Application of Statistical Concepts to the Wind Loading of Structures" (*ICE Proceedings,* 1961) has continued to impact the manner in which both tall and short buildings and bridges are analyzed and designed.

A soon-to-be published book on Alan's life, authored by Ms. Siobhan Roberts, and carrying his one-on-one discussions with her, has a working title of *In the Wind: Alan G. Davenport and the Art and Science of Wind Engineering*.

His widow Sheila remembers that:

> As a small boy Alan loved to create model airplanes. It was his interest in flight which was to eventually lead to his interest in wind and wind on structures. Sailing also always held an attraction for him and windsurfing was a favorite sport. He carried his interest in structures into family life. There are memories of picnics inevitably located under or near bridges so he could photograph the structures from the best vantage points.
>
> He encouraged his family to be adventurous. Always creative, with a whimsical sense of humor, he was adored by his family and his nine grandchildren.

But, in returning to the man, the father, the genius, the inventor, the theoretician, the innovator, the professor, we find a person who left a wave of inspirations that exceeds by far the ripple created by most of us. There is no room in this brief work to give proper weight to the nature of our friendship, the depths of my admiration for him, or the realistic and enormous contributions of his life to the built environments and to those who live and work in them. Alan Davenport's warmth, his modesty, and his good humor will be sorely missed.

Mr. Davenport is survived by his wife, the former Sheila Rand Smith; his sons Thomas and Andrew; his daughters Anna and Clare Davenport; and nine grandchildren.

H. TED DAVIS

1937–2009

Elected in 1988

"For leadership in applying chemical physics, and in uniting chemical engineering and materials science teaching and research."

BY EDWARD L. CUSSLER

H. TED DAVIS, regents professor at the University of Minnesota, died suddenly on May 17, 2009, at the age of 71. Ted was born August 2, 1937, in Hendersonville, North Carolina, the son of an apple farmer and a textile mill worker. He earned his bachelor's degree from Furman University and his Ph.D. in theoretical chemistry from the University of Chicago, working with Stuart Rice. After a postdoctoral year with Nobel laureate Ilya Prigogine at the Free University of Brussels, Ted joined the Department of Chemical Engineering (now Chemical Engineering and Materials Science) at the University of Minnesota, where he remained for 46 years.

Chemical engineering may seem a surprising destination for a theoretical chemist, but Ted was one of five chemists drawn to Minnesota at about the same time through the vision of Neal Amundson. Under the leadership first of Amundson and later of Ted, Minnesota's Department of Chemical Engineering and Materials Science grew with the dramatically expanding chemical industry and has been acknowledged as one of the top departments in the discipline for half a century. The growth of the department, and of the discipline, depended less on traditional unit operations and more on mathematical analysis. This strategy was appropriate because growth centered in the petroleum industry, where chemical composition could be described with continuous functions, rather than requiring only the periodic table. More recently, Ted led the expansion of chemical engineering into materials science, a continuing effort.

Ted's own research reflected this transition from theoretical chemistry to chemical engineering. He made significant contributions to statistical mechanics, interfacial phenomena, and transport in porous media. His work on tertiary oil recovery, a long-standing collaboration with L. E. Scriven, continues to supply part of the scientific underpinning for efforts to use as much of the world's oil supplies as efficiently as possible. I remain indebted to Ted for his efforts to teach me percolation theory. In all, Ted wrote over 400 papers and advised more than 80 graduate students. These intellectual accomplishments earned him the Walker Award from the American Institute of Chemical Engineers (1990) and election to the National Academy of Engineering (1988). In 1997, Davis was named a regents professor, the university's highest recognition for faculty excellence. He received a Humboldt Research Award in 2005, and in 2008 he was inducted into the first class of the Minnesota Science and Technology Hall of Fame.

In 1995, Ted Davis became dean of the Institute of Technology, Minnesota's college of physical science and engineering. During his tenure, he catalyzed establishment of the Digital Technology Center, the Department of Biomedical Engineering, and several programs in software and infrastructure engineering. As dean he not only seemed honest, but was honest. He also had the astonishing ability to change subjects effortlessly and to talk in depth about each: phase transitions, microwave bread baking, surface tension-driven instabilities, or improving his Corvette's acceleration.

All of us who knew Ted still miss him every day.

Preceded in death by his wife, Eugenia; he is survived by his second wife, Kathy; son, Bill; daughter, Maria; one granddaughter, Evyenia (Evy) Davis; and sisters, Gwen Spangler and Judy Fitzgerald.

VICTOR FROILANO BACHMANN DE MELLO

1926–2009

Elected in 1980

"For development of geotechnical engineering and international leadership in design of embankment dams and in situ testing for foundation design."

WRITTEN BY LUIZ GUILHERME DE MELLO
SUBMITTED BY THE NAE HOME SECRETARY

VICTOR DE MELLO, a Brazilian geotechnical engineer, died on January 1, 2009, at the age of 82. Son of a professor medical colonel M.P. (Member of Portuguese Parliament) and a German-Swiss mother, Victor de Mello was born in Goa, Portuguese India, on May 14, 1926. He attended British boarding school in India and then moved to Boston in 1944. As a brilliant student at the Massachusetts Institute of Technology (MIT), he obtained both his B.Sc. and M.Sc. in 1946 and his doctoral degree in 1948.

He immigrated to Brazil in 1949 to be a Brazilian, both because of deep-rooted cultural affinities with Goa and the nostalgic challenges of unopened frontiers of tropical civil engineering. It was in Brazil and from Brazil that Victor grew from his strong roots into a big tree, spreading his teachings to the four winds and the fruit of his works through countless projects built.

Victor's academic skills, nourished with Donald Taylor, led to a marked influence on MIT's shear strength and on the stabilization of clays research projects, the latter granting him a U.S. patent.

His enthusiasm for civil engineering involved action and creation on behalf of society, leading him to accept the invitation of the Light and Power Company, from São Paulo, Brazil, to join its department of hydroelectrical power new developments in late 1949. In 1951 he joined Geotecnica, a geotechnical engineering services, design, and construction company. Following a return to MIT in 1966-1967 as a senior visiting professor, Victor started his career as an individual consultant.

His main contributions were to embankment and gravity dam engineering, earth moving, tunnels and underground works, deep urban and port-lock excavations, foundations for high-rise buildings, bridges, industries, ports, jetties, breakwaters, highways, and railroads. One of his technical passions was probability and statistics applied to engineering design philosophy, together with risk analysis.

As an individual consultant or as a member of international advisory panels, Victor participated in the design and construction of major engineering projects: Emborcação, Foz do Areia, Guri, Pedra do Cavalo, Tucurui, Yacyreta, and hundreds of other dams in Brazil, in all of Latin America as well as elsewhere, such as Angola, Burkina Faso, China, Iraq, Iran, Mozambique, Turkey, and Tunisia. The research and developments proposed by Victor for the behavior of compacted saprolites and residual soils have influenced dam engineering throughout the world. His activities also included the design and follow-up of large open-pit mine projects in Brazil, the Imigrantes highway, the Ferrovia do Aço railway; geotechnical problems of the Confins, Galeão, and Manaus airports; and Açominas, Albras, Alumar, Alunorte, Camaçari, Cubatão, and Duque de Caxias refineries and steel and aluminum mills. One of his fascinating contributions was in the diagnosis of catastrophic slope destabilizations in Hong Kong from 1976 to 1979.

His professional vision was marked by intense job-generated research/observation and lonely mental experimentation and debates, with data and interpretation published worldwide. He emphasized the priority sequence of allegiances as, first, a world citizen and then a civil engineer for better fulfillment and finally, only subordinately, as a geotechnical specialist for better engineering. He preached the preeminence of creativity and of prescriptions rather than correlations, as dominating geotechnical engineering design. In lecturing on his select case histories, he always surprised by stressing from each case the lesson whereby the earnest optimized solution should principally indicate how not to repeat it, if the case chanced to present again.

An enthusiastic and intense perennial challenger and debater, Victor was often rightly misunderstood as disagreeing with his colleagues when he was really debating the topic and his own questionings. His approach has been exposed and expanded in some important papers, including the Rankine Lecture (1977); Foundations on Clays (1969); The Standard Penetration Test (1971); Thoughts on Soil Engineering Applicable to Residual Soils (1972); Some Lessons from Unsuspected, Real and Fictitious Problems in Earth Dam Engineering (1975); Philosophy of Statistics in Geotechnique (1975); Behaviour of Foundations and Structures (1977); Behavior of 2 High Rockfill Dams (1984); Foundations of Gravity Dams, Geomechanical Interaction (1984); Destabilization of Rockfill Slopes (1986); Embankment Dams and Dam Foundations (1989); Lessons of Adjustments to Tropical Saprolites and Laterites (1989); Revisiting Our Origins (1994); and Landslides by Maximized Infiltration: Fundamental Revision of Stability Calculations and Stabilizing Drainages (2003). Victor was working on a book on his visions on applied soil mechanics, which he left unfinished but which will be made available in the near future.

Some of the honors he received include being named an honorary member of many soil mechanics societies (Argentina, Japan, Portugal, Southeast Asia, Venezuela). He also was a fellow of the Third World Academy of Science in Trieste, Italy; a foreign associate of the National Academy of Engineering (U.S.); president of the International Society of Soil Mechanics and Geotechnical Engineering (1981–1985); vice president of the International Society for Rock Mechanics

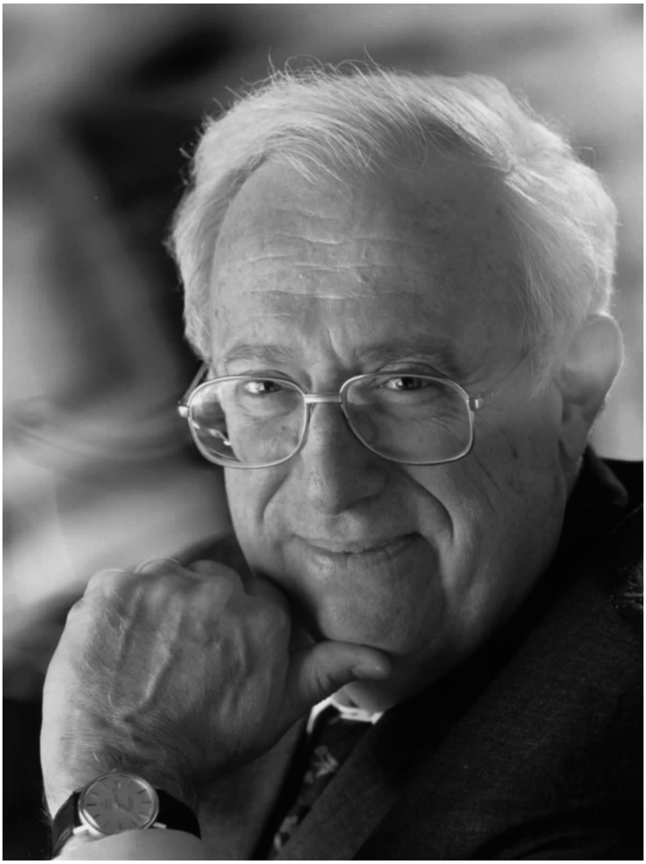
(1970–1974); founder and president of the Brazilian Society of Soil Mechanics and geotechnical Engineering (1964–1966); recipient of the Terzaghi Award twice in Brazil and of the Manuel Rocha Award in Portugal, Terzaghi; orator, ISSMFE (1994); and member of the National Academy of Engineering of Brazil and of Argentina.

In an attempt to honor Victor de Mello and celebrate his contributions to geotechnical engineering, the Brazilian and Portuguese geotechnical societies have created the Victor de Mello Lecture. The first lecture was delivered by John Burland in 2008.

Victor was also a special human being. His love and strong links to his brothers and sisters started early in their lives, with the six of them being educated at home in Goa; four obtained higher degrees in the United States. Family gatherings continue today.

Music, literature, dancing, wind surfing, and tennis were among Victor's interests. He played the piano, and this helped him find his way to MIT. His love of music included occidental classics, Portuguese *fados,* Brazilian popular music, and Indian *ragas.* Nature and art nurtured him; he changed his daily drive to the office according to which trees were flowering along the route. His wide cultural background led him to pursue knowledge from a multidisciplinary constellation of authors. And his habit of starting early each day included long, intensive working hours and also leisure and sports.

Professor de Mello died peacefully of a minor stroke at his home in São Paulo, after a long illness, amyotrophic lateral sclerosis (ALS, also called Lou Gehrig's disease). He leaves his wife Maria, his daughter Lucia Beatriz, his son Luiz Guilherme, and four grandchildren. A great human being, a true individual and friend, an outstanding practicing engineer has left our community.



MICHAEL L. DERTOUZOS

1936–2001

Elected in 1990

"For creative leadership in computer science, technology, and education."

BY VICTOR ZUE

MICHAEL LEONIDAS DERTOUZOS, professor of electrical engineering and computer science and longtime director of the Laboratory for Computer Science at the Massachusetts Institute of Technology (MIT), died on August 27, 2001, at the age of 64.

Michael was born on November 5, 1936, in Athens, Greece. His father was an admiral in the Greek navy and his mother was a concert pianist. These facts help explain both his lifelong love of sailing and his great interest in renaissance and baroque music. Upon graduating with a gymnasium diploma from Athens College in 1954, Michael moved from Athens to the Ozarks, having received a Fulbright scholarship to study electrical engineering at the University of Arkansas, where he received a bachelor's degree in 1957 and a master's degree in 1959. He then completed his Ph.D. in electrical engineering at MIT in three years (1964), having written his doctoral thesis on threshold logic. He immediately joined the faculty as an assistant professor.

Michael stayed at MIT for the rest of his life; he was promoted to full professor in 1973, and he was named the inaugural holder of the TIBCO Chair professorship in 2001. Michael's early teaching led to a two-volume co-authored text in 1972 integrating fundamental subjects in electrical engineering with computation. For this work he won the Terman Education Award in 1975, given to the best educator in all fields of engineering under 40 years of age.

Outside MIT, Michael gained experience as an entrepreneur by founding Computek, in 1968, to manufacture and market one of the earliest graphical display terminals based on one of his patents. He later became Computek's chairman of the board and introduced the first intelligent terminals.

In the early 1970s, Michael switched to computer science and joined Project MAC, which had been established by the U.S. Department of Defense at MIT in 1963. Project MAC set out to change the computational landscape with the development of time-shared computers and MULTICS, which laid the foundation for many of today's basic design concepts for software systems. In 1974, Michael was appointed as its fourth director. He renamed the project a year later as the Laboratory for Computer Science, or LCS, emphasizing the long-term nature of the research being undertaken by the laboratory. He stayed on as director of LCS for 26 years, until his death.

Michael was elected to the National Academy of Arts and Sciences in Greece in 1980. In 1990 he was inducted into the U.S. National Academy of Engineering for "creative leadership in computer science, technology and education." He received honorary doctorates from the Aristotelian University and the National Technical University in Greece.

Michael: The Visionary

Michael was first and foremost a visionary who spent much of the last quarter of the 20th century studying and forecasting future technological shifts. He had uncanny foresight, which he explained as the result of filtering his wildest technical imaginations through the sieve of human utility. Michael often thought of things years before anyone else did. For this he sometimes suffered premature ridicule. But he was invariably vindicated as time progressed.

In 1976, for example, he predicted that by the mid-1990s three out of every four homes would have desktop computers, which we now call PCs. As another example, in 1980 he wrote and spoke about the information marketplace, in which hundreds of millions of computers would be interconnected through a worldwide network, enabling billions of people to buy, sell, and freely exchange information. It took nearly 20 years for the Internet and the World Wide Web to revolutionize the world economy and to prove him right. As Moore's law begins to run its course in the next decade, it will soon become obvious that we need to seriously exploit distributed computing, which was a passion of Michael's since the 1970s.

Michael: The Leader

Michael is most remembered by lab members for his unique style of leadership. With his 6-foot 4-inch frame, Michael was an imposing figure whenever he entered a room. But he also had the rare gift of bringing people together to tackle complex problems, injecting energy and passion into the process and offering his insights and criticisms while preserving the dignity of his colleagues. All this he did with flair, often accompanied by food and festivities. In his opinion, we are never simply working. Rather, we are always having fun while being productive.

Regarding leadership, he was fond of quoting the Chinese philosopher Lao-zi: "Under the best leader, the subjects are hardly aware of his existence. Next are the leaders who inspire reverence and praise. Finally there are the leaders who are feared and despised." Lao-zi went on: "If a leader fails to inspire trust, then there must be cause for the distrust. A true leader can make things happen naturally, without the need for order or edict. When a true leader achieves success, he leads the subjects into believing that they did it all by themselves." For nearly three decades, LCS flourished under Michael's supreme leadership and the influence of his seemingly invisible hand.

Michael: The Technologist

Under Michael's leadership, LCS developed many of the technologies that underlie today's computer and information industry. Michael was a master at marshaling technical teams to bring coherence out of chaos. Two examples come to mind. The first concerned the development of the X Window system. The concept of windows in computer interfaces grew out of research at Xerox PARC in the 1970s. At MIT this notion was incorporated into the UNIX system and was first released in 1984 under the name "X Window." In 1988 Michael formed the "X Consortium" to produce a standard X Window system that would operate across computer platforms and operating systems. To this day, X Window continues to be a standard way of working across networked computers running Microsoft Windows, Mac OS, Unix, or Linux.

When the World Wide Web first started to take off, Michael conceived of a consortium in which member companies could work together to set standards, using academia as a neutral ground where decisions could be made. He persuaded the inventor of the World Wide Web, Tim Berners-Lee, to come to MIT and lead this effort. Since the mid-1990s, the World Wide Web consortium has been the leading force in maintaining coherence in the Web, providing standards for interoperability so that a multitude of browsers can access information from many different servers.

Michael: The Educator

Michael played a large role in bringing information technology into education at MIT. In 1982, for example, he co-founded a major educational project called Project Athena (named, following Michael's suggestion, after the Greek goddess of wisdom). The goal of Project Athena was to provide campus-wide computing infrastructure for education. Michael was instrumental in recruiting industrial participation, and he was on the executive committee for Project Athena for several years.

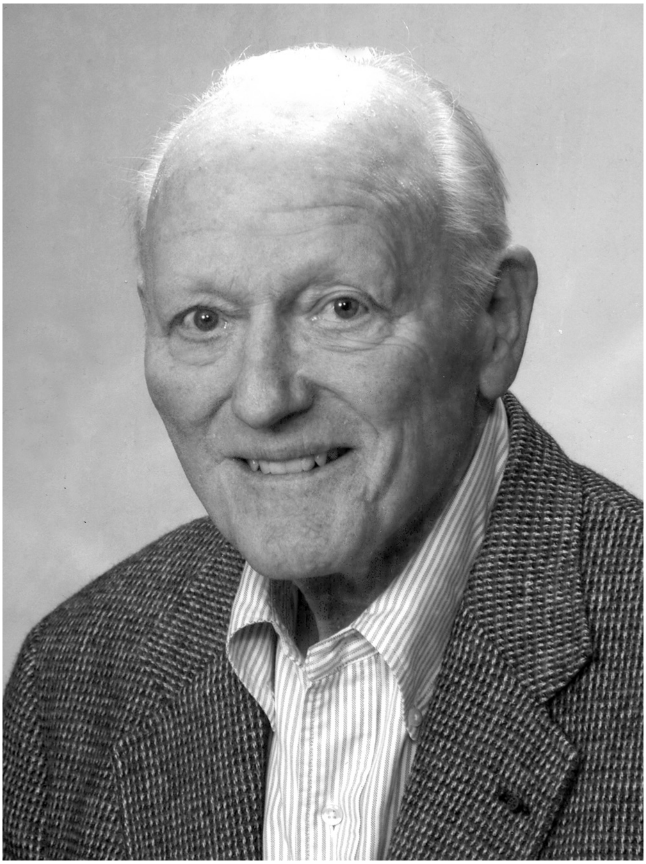
Michael was a quintessential teacher, and he taught in the most effective and endearing ways, through inspiration, by example, and always with passion. In his final interview, printed in the *Chronicle of Higher Education* a few days before his death, Michael spoke about the qualities that he valued most in teachers—qualities that were a fundamental part of his own approach to his interactions with the MIT community. In explaining his skepticism of computer-based distance education, Michael said, "Don't forget the impact that love has on education. If you are loved by your teacher—and I mean this in the most innocent and platonic sense—if your teacher really cares for your well-being—and you know that, because your teacher will ask about you, will scold you for not doing the right thing, and will give you stories about why you should do this or do that—the learning can be unbelievably different."

Michael: The Humanist

Throughout his career, Michael had always been interested in not only the development of computing and information technology but also the impact of technology on humans. Bill Gates, former chairman and chief software architect for Microsoft, said this about Michael: "More than anyone else in his field, Michael understood that technology—particularly computer technology—must serve people's needs, not the other way round. He was the first real 'technology humanist'—he believed that technology was largely worthless unless it truly enhanced human life, human communication, human work and play. He would often talk about his childhood in Greece, and I remember how passionate he was about what technology could do for countries such as his own."

Michael was the author of eight books. His last book was entitled *The Unfinished Revolution: Human-Centered Computers and What They Can Do for Us*. In the book he expressed his frustration with the gap between the humanistic promise that he had seen for computers and how things have turned out in the commercial world. Rather than being content as a critic, Michael decided to do something about it, and led the faculty and researchers of LCS and the artificial intelligence lab to create Project Oxygen, which is intended to make computers easier to use—"as natural a part of our environment as the air we breathe." He assembled an international team of corporate partners to form an alliance with MIT. Project Oxygen and pervasive human-centered computing together were his final legacy—a revolution unfinished.

Michael is survived by his wife, Catherine; two children from a previous marriage, Leonidas and Alexandra; and one granddaughter, Kiera.



COLEMAN DUPONT DONALDSON

1922–2009

Elected in 1979

"For research on supersonic diffusers, viscous vortex motion and turbulent transport phenomena, with application to solution of practical engineering problems."

BY DENNIS M. BUSHNELL

COLEMAN DUPONT DONALDSON, a giant in the development of aerospace and founder of Aeronautical Research Associates of Princeton, New Jersey, died August 7, 2009, at his home in Newport News, Virginia, at the age of 86.

Coleman Donaldson was elected to the National Academy of Engineering in 1979, "for research on supersonic diffusers, viscous vortex motion and turbulent transport phenomena, with application to practical engineering problems."

Dr. Donaldson was born on September 22, 1922, in Philadelphia to John Wilcox and Renee duPont Donaldson and was a grandson of Thomas Coleman duPont, president of E. I. duPont de Nemours and Company. He evidenced early on an intense lifelong interest in aviation, building a reproduction airplane on the roof of a barn at his parents' home and spending many hours "flying it." His father was an early naval aviator. He maintained a multiengine instrument pilot rating until very late in life. Aeronautics/aviation and aerospace defined the vast majority of his life's work and were a major personal passion.

Donaldson graduated with a B.S. in aeronautical engineering from Rensselaer Polytechnic Institute in 1942. He earned both master's (1954) and doctoral (1957) degrees in aeronautical engineering from Princeton University, where he was a student of Luigi Crocco. After graduation in 1942, he entered the U.S. Army Air Corps and was assigned to Wright Field and eventually the NACA Langley Memorial Laboratory in Hampton, Virginia. Donaldson began his aeronautical research career in these government laboratories and served as head of the Langley aerophysics section of the Gas Dynamics Laboratory from 1946 to 1952, when he left to pursue graduate education at Princeton University. There he founded, in 1954, Aeronautical Research Associates of Princeton, where he served first as president of the company and later as chairman of the board, until it was sold to the Titan Corporation in 1986. He then moved to his waterfront farm on the York River in southeastern Virginia and became a consultant to the federal government and industry. (The farm has been identified by archeological study as the site of the famous Captain John Smith–Pocahontas interaction in the early 1600s.) During his years at Princeton, Donaldson served as associate editor and, later, general editor of the landmark 12-volume Princeton series “High Speed Aeronautics and Jet Propulsion,” reporting to Theodore Von Karman. These extraordinary volumes were the “bible,” the resource reference during initiation of the Aerospace Age.

During his long research career, Coleman Donaldson contributed to an amazing variety of technical areas, including rarefied flow effects; MHD; flow separation; imperfect gas effects; transonic and supersonic aerodynamics (1940s to 1950s); weapons, hypersonics, and associated thermal protection issues (1950s to 1960s); wake vortices for both aircraft and submarines (1950s to 1980s); armor and antiarmor (1970s to 1980s); and the recurrent theme throughout most of his technical career—transition and turbulence modeling and associated computational fluid dynamics developments (1950s to 1980s). In his work on transonics in the 1940s, Donaldson developed an annular transonic facility, measured the first pressure distributions at Mach 1, and contributed to the development of the Bell X-1 and X-2 aircraft. He invented an active thermal protection approach which was sufficiently effective that the surface would not discolor during testing (one of his patents). He is credited with being a major force in the Navy's development of computational fluid dynamics as a ship/submarine design tool. He was the national expert on the aeronautical wake vortex hazard, with major contributions to research that enabled the safe entry of the 747 ("Heavy") class of aircraft into airline service.

Also in the vortex flow arena, Donaldson published a groundbreaking series of papers on three-dimensional Navier Stokes solutions for cylindrical vortices, indicating the possibilities of adjacent solution states, which could lead to bifurcations, providing insights into vortex-bursting phenomena. He developed the canonical testing approach to evaluate advanced armor materials, which is still in use today, and he invented an improved projectile/penetrator.

Perhaps his most substantial and best-known works involved second-order closure for modeling of transitional and turbulent flows. These works were employed for a wide variety of national security problems as well as civilian applications. His work decoupled the modeling of turbulent fluxes from unique dependence on mean flow and led to very extensive subsequent worldwide research and application efforts in the field. Application examples of this body of work include the evaluation of atmospheric particulate effects on U.S. Air Force intercontinental ballistic missile reentry vehicle boundary layer transition, pollution/effluent dispersion in the atmosphere and estuarine systems, and chemically reacting system understanding and optimization.

Donaldson's many honors include membership in the National Academy of Engineering. He was a fellow of the American Institute of Aeronautics and Astronautics (AIAA) and the Explorers Club. He received the Meritorious Public Service Award from the Chief of Naval Research and the AIAA Dryden Research Lecture Award. He was chosen to serve as Robert H. Goddard Visiting Professor at Princeton University and as general chairman of the AIAA's 13th Aerospace Sciences Meeting. Donaldson was a member of Sigma Xi and the American Physical Society. His committee service included the Advanced Research Projects Agency Submarine

Technology Advisory Panel; the Advisory Committee for the National Aeronautics and Space Administration (NASA)-Stanford Center for Turbulence Research; the Naval Research Advisory Committee; the NASA Special Panel on Hypersonic Flow, Advisory Council; the Department of Aerospace and Mechanical Engineering, Princeton University; the Industrial Professional Advisory Council; the College of Engineering, Pennsylvania State University; the NRAC Laboratory Advisory Board for Air Warfare and Marine Corps Panel; the NASA Research and Technology Advisory Council; the President's Air Quality Advisory Board; and the NACA Special Subcommittee on Aircraft Noise, under General James H. Doolittle.

Coleman Donaldson had many personal passions, including flying, sailing, building and repairing period furniture, supporting in many ways historic preservation, playing the piano and guitar, dancing, and tennis. He was a voracious reader and a student of Jefferson, Washington, Madison, Churchill, Gandhi, and other statesmen. His favorite furniture periods were Queen Anne and Chippendale. He sailed competitively in several Miami-to-Nassau races, including a stint as a crew member for Bus Mosbacher, winner of the America's Cup, and he cruised the Chesapeake Bay on his Staysail schooner. He was a staunch supporter of the Association for the Preservation of Virginia Antiquities and the National Trust for Historic Preservation.

Coleman Donaldson is survived by his wife of 64 years, Barbara Goldsmith Donaldson of Newport News and five children—Beirne Donaldson of Mendham, New Jersey; Coleman Donaldson, Jr., of Agoura Hills, California; Evan Donaldson of McLean, Virginia; Alexander Donaldson of Rayleigh, North Carolina; and William Donaldson of Newport News—as well as a brother, a sister, and eight grandchildren.

Among his most valuable services to the nation was as a superb critic and reviewer. Donaldson combined a masterful grasp of the fundamentals with a personality that was not bashful and provided the national security community with invaluable advice, along with many unique solution approaches for critical national problems. Overall, his was a wonderful, exceedingly productive, long life, lived well. We are still working on his ideas.

JACKSON LELAND DURKEE

1922–2007

Elected in 1995

"For origination and development of innovations in fabrication and erection engineering of long-span bridges."

BY IVAN M. VIEST

AN ENGINEER'S ENGINEER, Jackson Leland Durkee provided guidance in the design, construction, evaluation, and rehabilitation of about two dozen major bridges and other steel structures located in eleven countries on four continents. An independent consulting structural engineer in a field that is almost without exception handled by employees of a variety of companies, his unique services were sought after by numerous clients.

Son of the late civil engineer E. Leland Durkee, Jackson was born on September 20, 1922, in Tatanager, India, where his father was erecting bridges for Bethlehem Steel Company. He received bachelor's and master's degrees in civil engineering from Worcester Polytechnic Institute (1941) and Cornell University (1947), respectively. Worcester Polytechnic awarded Jackson a CE degree in 1951. He began his professional life as a designer and structures test engineer for Douglas Aircraft Company in California. From 1944 to 1946, Jackson served his country in World War II as a naval deck officer in the Pacific Fleet. In 1947, Jackson joined Bethlehem Steel where he worked for 29 years. He was employed in various divisions of the company, attaining the position of Chief Bridge Engineer in 1965. His significant bridgework accomplishments while with Bethlehem Steel included, among others, the Second Tacoma Narrows Bridge in the state of Washington, the first Chesapeake Bay Bridge in Maryland, and the Narragansett Bay Bridge in Rhode Island.

Jackson originated and directed Bethlehem Steel's research and development of the prefabricated parallel-wire strand system for main supporting cables of suspension bridges. On Durkee's recommendation, such cables were first used in 1968 on the suspension bridge over Narragansett Bay near Newport, Rhode Island, and on the suspension spans of the second Chesapeake Bay bridge near Annapolis, Maryland, completed in 1973. Their most extensive application was on suspension bridges in Japan, including the vast Honshu-Shikoku crossings and the Akashi Kaikyo Bridge with the world's longest main span. The prefabricated parallel-wire strand system replaced the aerial spinning method of parallel-wire cable construction developed by bridge builder John A. Roebling in the 1840s. Jackson was listed as a co-inventor on seven U.S. suspension bridge patents and on more than 40 derivative foreign patents. The original patents were issued to Bethlehem Steel Corporation in connection with the shop-fabricated parallel-wire bridge strand, pipe-type cable anchorages, cable-supporting saddles, and plastic bridge cable covering.

Upon retirement from Bethlehem Steel, Jackson served as a Visiting Professor of Structural Engineering at Cornell University during the spring term of 1976 and, for a brief period, became a partner in the consulting firm Modjeski and Masters of Mechanicsburg, Pennsylvania. He then opened his private international consulting practice in Bethlehem. His professional career included projects in the United States, Canada, Great Britain, Portugal, Germany, Denmark, Italy, Japan, China, Hong Kong, and South Africa. He was the only American on the International Board of Consulting Engineers that planned the construction of the Messina Strait suspension bridge to connect the mainland of Italy with the island of Sicily. He served as an expert engineering witness for over 22 years, including his trial participation with the

Kansas City Hyatt walkway collapse. Jackson was a registered professional engineer in Pennsylvania, California, New York, and Connecticut; and was a Chartered Engineer in the United Kingdom and the European Community. Among his numerous papers on bridge engineering, the *Erection Strength Adequacy of Long Truss Cantilevers,* co-authored with Spiro S. Thomaides and published in 1977, exemplifies the significant content and clear writing that were characteristic of Jackson's papers.

The following were some of the many projects in the United States completed with Jackson's involvement:

- Wheeling Suspension Bridge, Wheeling, West Virginia, 1979–1981
- Hale Boggs Cable-Stayed Bridge, Luling, Louisiana, 1980–1983
- Brooklyn, Williamsburg and Manhattan Bridge Evaluation and Rehabilitation, 1982–1988
- Tennessee River Girder Bridge Failure During Erection, 1999
- East Bay Suspension Bridge, San Francisco, 1999–2007
- Patton Island Girder Bridge, Muscle Shoals, Alabama, 2002–2004
- Golden Gate Bridge, San Francisco, 2004–2007.

Jackson was elected to the National Academy of Engineering in 1995 and was a regular participant in its annual meetings. He was an Honorary Member of the American Society of Civil Engineers; a fellow of two British engineering societies, the Institution of Civil Engineers and the Institution of Structural Engineers; and a member of the International Association for Bridge and Structural Engineering. He served on several committees of the above organizations as well as of the Transportation Research Board of the National Research Council. Among the many recognitions of his contributions are the Ernest E. Howard Award of the American Society of Civil Engineers, the Robert H. Goddard Award of the Worcester Polytechnic Institute, and the John A. Roebling Medal of the International Bridge Engineering Conference—the Engineers' Society of Western Pennsylvania.

Outside his engineering activities, Jackson was concerned with competitive enterprise and economic research. For example, he participated in the Fifth Institute on Freedom and Competitive Enterprise at Claremont Men's College in 1958, and in 2006 became a voting member of the Corporation, the American Institute for Economic Research. He was an avid outdoors-man, golfer, and traveler. A true believer in the benefits of physical fitness, Jackson continued regular exercises for many years and gave preference to a bicycle over an automobile whenever practical. He was a member of a couple of golf clubs at St. Andrews in Scotland, doing his best never to miss an opportunity to play their links. His list of memberships included Cosmos Club in Washington, D.C., and Central Moravian Church in Bethlehem.

Jackson died on June 14, 2007. His wife Marian died in March 2010. He is survived by three daughters: Janice and her husband Blake Tarry of New Hope, Pennsylvania; Judith and her husband Clay Burton of Chadds Ford, Pennsylvania; Christine and her husband, Robert Simpson of Nazareth, Pennsylvania; seven grandchildren and a great-grandson.

Jackson Leland Durkee was a unique person who stood out among his peers as a colorful individual.

His daughter wrote:

> The Durkee family would like to express its great appreciation to Mr. Ivan Viest for the thoughtful memorial that he wrote for our father, Jackson Leland Durkee. Mr. Viest worked closely with Jackson for many decades and was intimately acquainted with Jackson's engineering achievements. His tribute stands alone as a statement of the great professional and personal relationship they both shared. The following are some affectionate family memories to add to Mr. Viest's invaluable contribution.
>
> Jackson was both a sophisticated and a simple man. He was a highly disciplined intellectual with an old-fashioned sentimental streak. Every Valentine's Day, a fragrant gardenia never failed to arrive at the front door. He avoided large social gatherings but loved to dance

and privately entertain. He and his wife Marian would frequently rumba in the living room with the Magnavox on high volume in their little 1954 house. Always well dressed and well tailored, Jackson saved his pennies with a simple do-it-yourself home haircut. He had a great love of music and drove his family to the elegant New York Opera House every year. Afterwards, the corner steakhouse was the inexpensive (and required) restaurant of choice for this meat and potatoes man.

Jackson and his oldest daughter (Janice) enjoyed listening to classical music—especially at dinnertime. He conducted his “air baton” with great flair at the dining room table, and nodded approvingly as she correctly identified the great symphony movements. He bought her a piano when she was a teenager that she still practices on today. They also shared a love of literature and she has acquired his beloved Harvard Classics from his extensive library.

Jackson outfitted his middle daughter (Judith) with her very own engineering hard hat and special shoes. Starting when Judith was 8, he took his little pupil out on weekend trips to inspect bridges and steel mills. In the evenings she sat on his work stool, while he taught her the “proper method” of positioning the slide on his drafting board. He worked tirelessly with her on a science fair project displaying miniature bridges made of balsa wood. They were the two talkers in the family who enjoyed many hours of economic and political debate together.

With his youngest daughter (Christine), Jackson shared his love of travel. He took her on the family camping trip, starting at age two, and of course, he insisted she learn to fill her own water cup. He encouraged her to spend her junior year abroad to study in Scotland—well before it was commonplace in the college curriculum. He visited her at Edinburgh University. It was there that Jackson fell in love with St. Andrews Golf Course and the rest is history. The family subsequently surprised him with a hand-carved chess set from the Isle of Lewis—one of his lasting treasures.

Jackson's family remembers with fondness (and a little groan) his frequent Sunday morning greeting: "FB on the P with WC" (family breakfast on the porch with witty conversation). As Pancake King, he reigned over breakfasts that were both lively and contentious. He passed "WC" on to his seven grandchildren who endured his exacting historical and literary quizzes. Their reward was a ride on his motorcycle and more "WC". In his later years, when his great-grandson would run in to visit, "GranDad" would stretch out on the floor to eagerly engage his newest protégé.

Jackson's gifts to his family were his love of learning, his unlimited enthusiasm for adventure, and his photo albums that carefully recorded every detail of a full and accomplished life. He was a towering figure in his children's lives—he demanded much of them and much of himself. Jackson's engineering expertise and achievements were highly regarded by his peers. The family is appreciative for the honors and professional recognition he received from the engineering community during his lifetime.

GUNNAR FANT

1919–2009

Elected in 1982

"For pioneering development of acoustic theory of speech production and innovative leadership in communications technology and in development of prosthetic devices."

BY JAMES L. FLANAGAN, HANS G. FORSBERG AND WILLIAM W. LANG

GUNNAR FANT, a pioneer in research on human speech, died on June 6, 2009. Gunnar was internationally respected for his contributions to an understanding of how the sounds of speech are shaped by the human vocal tract and for his fundamental contributions to the fields of speech communication and human language analysis. His work during the latter half of the 20th century set research patterns and techniques for a generation of students and researchers of speech science.

Gunnar was born in Nyköping, Sweden, on October 8, 1919. His studies and degrees, indeed almost all of his technical career, were spent at the Royal Institute of Technology (KTH) in Stockholm. He received his master's degree in electrical engineering in 1945, with a thesis on how the understanding of speech depends on interference and telephonic limitations in its transmission. For a short time he was employed in the telephone research laboratory of the Ericsson Group, where he carried out acoustical analyses of the sounds of Swedish speech and worked on problems related to the transfer of speech through telephone cables.

In 1949, at the invitation of Leo Beranek, whom he met on Leo's visit to the Ericsson laboratory, Gunnar came to the Massachusetts Institute of Technology (MIT) and Harvard as a visiting scholar. His interactions with linguists beginning with Roman Jakobson and Morris Halle introduced a quantitative engineering component to the study of language. Their collaboration led to the publication of an MIT report in 1952, after Gunnar had returned to Sweden. Titled "Preliminaries to Speech Analysis—The Distinctive Features and Their Correlates," the vision and grasp of the report engage linguists to the present day. He also initiated a career-long interaction with the speech group at MIT under Ken Stevens. He applied his knowledge of signal processing and acoustics to the study of human production and the perception of speech sounds and to a potential universal organization of basic phonological units.

Returning to Sweden in 1951, Gunnar established the Speech Transmission Laboratory at KTH. It quickly became a world center for speech research and related technical developments—all aspects of speech processing, including analysis, synthesis, recognition, production, and perception. The STL was also involved with prosthetic engineering that included speech training devices for the deaf and reading machines for the blind.

By 1958 Gunnar had assembled his research into a monumental doctoral dissertation which included a book, *The Acoustic Theory of Speech Production* (Mouton, 1960), and a monograph, *Acoustic Analysis of Speech with Applications to Swedish* (Ericsson Technics, 1959). His theory describes in general what speech is physically and explains how vowels and consonants are formed to produce distinctive acoustical characteristics. This was a pioneering quantitative advance on how speech sounds are generated and filtered by the dynamically changing vocal tract. These publications, especially his book, quickly became standard references in the field of speech processing. Gunnar's theory underlies much of the current technology of voice communication by analysis-synthesis methods. His description of speech is general—independent of language, valid for both normal and distorted speech, and covering the human voice both singing and speaking. He used this theory to design a series of speech synthesizers; a commercial version (OVE III) enjoyed wide use because of the quality of both its speech and its engineering. He also developed an improved vocoder that Ericsson built for military use.

Over a period of more than four decades, Gunnar attracted and worked with many colleagues and students on a variety of topics related to speech technology, speech disorders and acquisition, and other aspects of speech and language. His mode of interaction was informal, with coffee breaks and friendly discussion on many topics. Each year his laboratory produced progress reports that were referenced by researchers around the world.

In 1961 Gunnar received the Gold Medal of the Royal Swedish Academy of Engineering Sciences (IVA). He was elected a member of IVA in 1963—one the youngest members—and became professor at KTH in 1966. He was elected a foreign associate of the National Academy of Engineering in 1982. Gunnar retired formally in 1987 but remained a leading scientist at KTH until his death in 2009.

Gunnar received many other honors during his over 50 years in the field. In 1980 he received the Silver Medal of the Acoustical Society of America. In 1985 he was jointly named with Jim Flanagan to share the L. M. Ericsson International Prize in Telecommunications. In 2004 Gunnar received jointly with Ken Stevens the Institute of Electrical and Electronics Engineers (IEEE) Signal Processing Society's James L. Flanagan Speech and Audio Processing Award.

Gunnar created a unique fellowship within his laboratory and with colleagues worldwide that was characterized by friendship, caring, respect, scientific freedom, and collaboration. For all of us who knew him and worked with him, he leaves deep loss, but with many fond memories, both technical and social. He is survived by his daughter, Maria Fant Laitanen, and his son, Anders Fant.

IRENE K. FISCHER

1907–2009

Elected in 1979

"Pioneering in geoid studies for application to defense and space programs in connection with development of a unified world geodetic system."

BY BERNARD CHOVITZ
AND MICHAEL M. J. FISCHER
SUBMITTED BY THE NAE HOME SECRETARY

IRENE KAMINKA FISCHER, the grande dame of 20th-century geodesy, died on October 22, 2009, at the age of 102. During her 25 years at the U.S. Army Map Service and its successor agencies, spanning the period 1952 to 1977, she established an unmatched scientific record. Among the notable achievements that she participated in or was wholly responsible for were the revision of the International Ellipsoid in 1956, the refining of the National Aeronautics and Space Administration (NASA) reference ellipsoid for satellite tracking, the transfer of astrogeodetic deflections of the vertical into geoid contours, the construction of the U.S. Department of Defense (DOD) 1960 World Geodetic System (a.k.a. the Fischer Ellipsoid or Mercury Datum of 1960, modified in 1968), the creation of the South American 1969 Datum, the reconciliation of oceanographic leveling with geodetic leveling, and the construction of oceanic calibration zones for satellite altimetry. (A more complete summary of her work can be found in a centennial tribute to her appearing in Survey Review, July 2007).

Irene Fischer's workplace recognized her accomplishments by naming her to its hall of fame and presenting her with the DOD's Distinguished Civilian Service Award and the U.S. Army's Meritorious Civilian Service Medal. Her peers elected her a fellow of the American Geophysical Union, and in 1979 she was elected to the National Academy of Engineering. The University of Karlsruhe granted her an honorary doctorate. An Earth spheroid employed operationally by NASA in the 1960s bore her name. After her retirement from U.S. government service, she received the first Federal Retiree of the Year Award. The successor to her agency, the National Geospatial-Intelligence Agency facility, has named its Learning Center on its new campus at Fort Belvoir, Virginia, scheduled for completion in 2011, in her honor

Born and educated in Vienna, Austria, Irene Fischer studied descriptive and projective geometry at the Technical University of Vienna and mathematics at the University of Vienna. Her teachers Moritz Schlick and Hans Hahn were among the luminaries of the Vienna Circle; and her fellow students included physicist Victor Weiskopf, sociologist Paul Lazarsfeld, and social psychologist Marie Jahoda. Her father, Rabbi Armand / Aaron Kaminka, was head of the Maimonides Institute and regularly led high holiday services at the famed Vienna Musikverein. He worked for the Alliance Israelite, investigating pogroms in Eastern Europe, and raised money in the United States and Western Europe to help victims.

In 1930 Irene married historian and geographer Eric Fischer, who helped introduce U.S. history, as distinct from British history, to Vienna. The Fischer family founded and ran the Vienna Kinderbewahranstallt, the first professional kindergarten and kindergarten teacher training school in Vienna, a place that also became a refuge for immigrants to Vienna from Eastern Europe.

In 1939 the Fischers, with their young daughter, Gay, fled Nazi Austria, traveling by rail to Italy, by boat to Palestine, and in 1941 by boat around East Africa and the Cape of Good Hope to Boston, where they lived with Eric Fischer's sister, mother, and brother-in-law, the physician Otto Ehrentheil, and their two daughters. Looking for jobs, Irene Fischer first worked as a seamstress assistant; then she graded blue books for Vassily Leontief at Harvard and for Norbert Wiener at the Massachusetts Institute of Technology (MIT). She also worked on stereoscopic projective geometry trajectories for John Rule at MIT. She taught mathematics at Brown and Nichols Preparatory School in Cambridge and then at Sidwell Friends in Washington, D.C.

In 1952 Irene joined the Army Map Service as a mathematician in the Research and Analysis Branch of the Geodetic Division. Subsequently, she attained the position of chief of the geoid branch of that division, which she held until her retirement. Her entry into geodetic science coincided with three remarkable breakthroughs in that field in the 1950s. First, the arrival of artificial satellites and space techniques enormously multiplied the quantity and scope of geodetic observations. She was fortunate to have John O'Keefe, a pioneer of the satellite era, as an initial mentor. Second, the introduction of electronic computers enabled data to be handled much more expeditiously. The Army Map Service was the recipient of one of the first of these computers—the UNIVAC. Third, widened support for geodetic programs was recognized as essential for national security and enabled resources to flow to her agency. During Fischer's tenure, and due in large part to her contributions, the Army Map Service became acknowledged as one of the key centers of geodetic activities in the country.

Apart from her research activities, Fischer was an outstanding expositor. For example, she wrote articles for *The Mathematics Teacher* to explain basic geodetic concepts and results to students, and she published a geometry textbook. Geodetic history was one of her favorite avocations (cf. "At the Dawn of Geodesy," *Bull. Géodésique,* June 1981). Her agency took advantage of her reputation and skills, both written and oral, for innumerable presentations to high-ranking government authorities. Fischer was an engaged member of the worldwide geodetic community, and she developed close friendships with leading geodesists in many countries, especially Guy Bomford and Erik Tengström. Starting with the Toronto (IAG) General Assembly in 1957, she and her husband became well-known participants at international geodetic gatherings. Almost immediately she joined, and eventually headed, several IAG special study groups, and at the 1963 Berkeley assembly she was elected a section secretary. Inevitably she would have attained at least a section presidency, but unfortunately her agency refused permission for her to attend the 1971 assembly in Moscow, when she would have been considered for that office. However, her many friends were gratified to see her and Eric again at the 1975 Grenoble and 1979 Canberra meetings. One of Fischer's most lasting legacies is her unconventional memoir, *Geodesy? What's That? My Personal Involvement in the Age-Old Quest for the Size and Shape of the Earth,* a fascinating, detailed account of her 25 years as a research geodesist. It provides a unique window into this critical transition period for geodesy and many other sciences. Fischer frankly describes her handicaps as a female in the male-oriented environment of the 1950s and the bureaucratic obstructions she faced. But she also gave "tribute to the many friendly souls at all levels who made my government service such an interesting and satisfying experience."

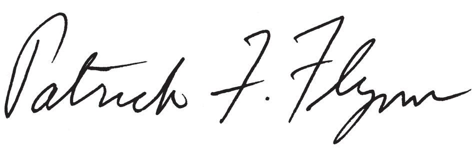
Not just an expositor of geodesy, Fischer also loved to teach and delighted in writing introductory texts. Already in Palestine in 1941 she had created and taught a short-hand for Hebrew, dedicated to the memory of her father-in-law, who had been a stenographer in parliament in Vienna until he was terminated at the demand of some parliamentarians that a Jew not be recording their words. Her "Basic Geodesy" was a popular item in its time. She was delighted to be the first woman to be invited to address the all-male Cosmos Club. Like her father, she was a good linguist, and she taught herself Russian so that she could read their technical literature, helped teach her colleagues some basic German, and then taught herself Yiddish in order to research the history of the village from which her father had come.

Irene loved her carpenter-built house in Takoma Park, Maryland, and her garden with its raspberry patch and figs.

After 12 years of moving every two or three years (Vienna, Palestine, Boston, Washington, Charlottesville, New York, Washington), she put down deep roots in Washington. She was active for many years at Temple Israel in Silver Spring, Maryland, where she also taught an adult class in basic Hebrew, and was an active member of a 40-year-long *chavura* (discussion group). She loved to entertain foreign and local colleagues and for family occasions was a great cook and baker of Viennese Sacher, Dobosh, and Linzer Torten and other delicacies. As a mother she was proud of her daughter, who followed her mathematical talents to become one of the first-generation systems programmers, working after college for the Army Map Service as a liaison to Honeywell on the big mainframe that AMS obtained and writing a high school algebra textbook in the same series as Irene's own geometry book. Her son academically followed more in his father's line, becoming an anthropologist. Fischer loved traveling with her husband, always using meetings as an occasion for a family geographical exploration across the United States and to all five continents. In 1992 she took her family to Spain with the Washington Hebrew Congregation on the 50th anniversary of the expulsion of the Jews, visiting Toledo and other Jewish sites and making sure to be in Granada on the day of the commemorative proclamation.

As a boy, I (Michael) grew up learning about geodesy from her, *tektites* from Dr. O'Keefe, geometry as a beta tester for her geometry textbook, and was fascinated by her stories about the people of the Vienna Circle as I began studying philosophy in college. Eventually, when I became an anthropologist of science and technology at MIT, I used to enjoy thinking about Irene as a young woman there and of her as a student entering the Technical University in Vienna as if it were MIT. I was particularly fortunate to have had parents who not only were supportive but who were also throughout my life emotional and intellectual companions, sharing their many interests scientific, historical, and familial.

When my mother finally gave up her beloved house in Takoma Park and moved nearby to Rockville, to be near close friends, she endowed a Biblical archeology lecture series in her husband's memory at the Rockville Jewish Community Center. In Israel, where many family members live, she and my father had endowed fellowships to a technical college, as well as being supporters of Haddassah (a life member of the Bialik chapter). In 2001 she moved back to Brighton, Massachusetts, three blocks from where she had first lived as an immigrant in 1941. She is survived by her daughter, Gay A. Fischer, of Oberlin, Ohio, and her son and daughter-in-law, Michael and Susann.


Patrick F. Flynn

PATRICK F. FLYNN

1937–2008

Elected in 1995

"For advances in diesel engine design utilizing science-based methodology."

BY RODICA A. BARANESCU
AND COLLEAGUES AT CUMMINS, INC.

PATRICK FRANCIS FLYNN, one of the nation's foremost engine combustion experts, died on August 19, 2008, at the age of 70.

Born in Kingsley, Iowa, on November 14, 1937, he was the oldest of five children, growing up in Minnesota, where his family operated a farm. With a humble, strong work ethic firmly rooted, he went to college at the University of Minnesota (where he had plumbing for the first time). He was notoriously known for not having to study in college and graduated with a B.S. in agricultural engineering *(cum laude)* from the university in 1959.

After graduation he joined the John Deere Company in East Moline, Illinois, as a design engineer. From there he moved on to the International Harvester Company, where he was a design and project engineer. It was there where he first developed a special interest in engine combustion and co-authored his first papers for the Society of Automotive Engineers, relating to diesel engine simulation and testing. While at International Harvester Company, Pat also worked on his M.S. degree in agricultural engineering, which he obtained in 1965 from the University of Minnesota.

In January 1967, Pat left International Harvester Company to pursue a Ph.D. in mechanical engineering at the University of Wisconsin. There he met Beverly Collora, and they were married on August 30, 1969. Pat and Bev both earned doctoral degrees.

After being awarded his Ph.D. in 1971, Pat joined Cummins Engine Company in Columbus, Indiana, as a technical specialist in the advanced development area. During his 32 years at Cummins, he held a variety of technical and managerial positions, including manager of advanced development, director of turbo machinery research, director of performance and emissions development, and executive director of design and mechanical analysis.

In addition to his technical education, Pat earned an M.B.A. in administration from Indiana University in 1977 while working at Cummins. During his career at Cummins, he received numerous awards—the Outstanding Achievement Award from the University of Minnesota Board of Regents; the Distinguished Service Citation from the College of Engineering at the University of Wisconsin; and the Engine Manufacturers Association Outstanding Achievement Award.

Pat was elected to the National Academy of Engineering in 1995 and was an active member of the National Research Council's Board of Army Science and Technology from 1999 to his death. Pat also served as a member of the Combustion Institute and the advisory board of the Combustion Research Facility of the U.S. Department of Energy (DOE), Sandia National Laboratories, and as a member of the Executive Advisory Board of the Department of the Army's University Research Initiative and DOE's Office of Heavy Vehicle Technologies. Pat was a registered professional engineer with the State of Indiana and a fellow of the Society of Automotive Engineers and the American Society of Mechanical Engineers (ASME).

In 1981, while Pat was still employed by Cummins, he and Beverly took sabbaticals from their jobs to teach at Churchill College at the University of Cambridge, in Cambridge, England. They were the first husband-and-wife team in the university's history. In addition to his teaching assignments, Pat continued his research into new perspectives of diesel engine combustion and performance analysis.

In 1985, Pat was promoted to vice president of design and technology. The final 11 years of his career at Cummins were spent directing corporate efforts in combustion research and development of diesel and alternate-fueled engines as vice president of research. During those years at Cummins, Pat managed and directed the efforts of over 100 scientists and engineers, focusing their work on application of the fundamental sciences to the improvement of engines.

Pat always challenged his organization to base its work on the fundamentals of science and technology. One of his favorite sayings was, "If it does not work on paper, it will not work in hardware." He led by example, and his research in the area of combustion and exhaust emissions has had a profound impact not only on Cummins but on the entire industry.

On the occasion of Pat's retirement from Cummins in 2000, Chairman and CEO Tim Solso noted, "In his time at Cummins, Pat has led the development of some of our most significant new platforms. The contribution he has made to our technical organization has been substantial."

Pat Flynn authored and co-authored many technical papers relating to engine combustion, performance, and exhaust emissions and presented such publications in the United States and abroad. In September 2001, Pat delivered the "Soichiro Honda Lecture" at the annual ASME convention entitled "How Chemistry Controls Engine Design." During his career, Pat was granted numerous patents ranging from turbo machinery to optimizing combustion control in compression ignition engines.

Like his work, Pat loved his family and life. He and Bev enjoyed their two children and closely followed their academic and sporting achievements. They were able to travel extensively, annually, taking their children along on some of their more exotic international trips.

Pat was a fierce competitor in and outside the intellectual arena. He was intense on the tennis court and played a good game of golf, one of his favorite pastimes. He kept in good shape by riding his bike about 10 miles most days.

Pat dedicated his professional life to improving the understanding of the combustion process in internal combustion engines. Even after his retirement from Cummins, he continued to work diligently on diesel combustion modeling using Second Law of Thermodynamics analysis to demonstrate potential improvements in diesel engine performance. He also continued developing complex simulation methods to further understanding and improvement of the combustion process in both spark-ignited and compression ignition engines.

Pat started a consulting company called KFB Consulting. The KFB stood for "Keep Flynn Busy." He continued doing research, saying, "I'll stick my pick in whenever I see an opportunity." And with this attitude he leaves behind a theory he had not yet verified on how combustion "really works," which he believed would open many new avenues of research and use. He truly was an excellent role model of the concept of lifelong learning.

Pat used to gently put his hand on your shoulder and say the kind words, "We've got to talk!" He was known for regular reality checks, had an infinite ability to see when the ducks were not in a row, and made back-of-the-envelope calculations. But perhaps his ability to focus on the business at hand was only exceeded by his ability to motivate people to work hard. His brilliant career was filled with passionate and caring guidance, great motivation and leadership, and inspirational words.

Pat was preceded in death by his wife on January 19, 2005. They both left a great legacy of education. Pat and Beverly were very interested in giving the opportunity to go to college to first-generation families, just as he had done. Together they quietly created scholarships and continuously were big contributors to the University of Minnesota, University of Wisconsin, and Indiana University.

So at the end of an amazing life's journey, some Flynn-isms to live by: "There are too many birds that are not in the box yet," so, "The sooner we pre-think this the better." We might all do well to look forward and get thinking.

John W. Fondahl

JOHN W. FONDAHL

1924–2008

Elected in 1993

"For innovations in methods of construction project controls and in graduate education."

BY THE FONDAHL FAMILY
SUBMITTED BY THE NAE HOME SECRETARY

JOHN FONDAHL, developer of planning techniques for complex construction projects and co-founder of the Stanford Construction Program, died September 13, 2008, at the age of 83. John was elected to the National Academy of Engineering (NAE) in 1993 and cited for innovations in methods of construction project controls and in graduate education.

John was born in 1924 in Washington, D.C. He met his future wife, Doris-Jane, in 1939 at McKinley Tech High School. During high school he was captain of a champion rifle team and an active member of the Cadet Corps. He graduated valedictorian in 1941. He received a four-year scholarship to Worcester Polytechnic Institute, while Doris enrolled at Mount Holyoke, about 50 miles away. Pearl Harbor changed everything—after one year of college, John entered the military, serving in the Pacific Theater with the Fifth Amphibious Corps of the U.S. Marines. John, a sergeant, and his father, a Lt. Colonel in a different Marine Corps outfit, were both Iwo Jima survivors. Upon returning, he entered Dartmouth College to study civil engineering. He married Doris in 1946. John received his M.S. in civil engineering from Dartmouth in 1947 and later became a registered civil engineer in California.

John worked as an engineer and structural detailer with the American Bridge Company in Pittsburgh, Pennsylvania, from 1947 to 1948. This experience increased his understanding of design practice but also encouraged him to gain construction experience. After teaching civil engineering at the University of Hawaii from 1948 to 1951, John spent one year as an engineer and estimator with Winston Brothers Company in Minneapolis, Minnesota. He then moved his family to Sacramento to work with Winston Brothers and the Al Johnson Construction Company as project engineer on the Nimbus Dam and Powerhouse Project from 1952 to 1955. His analysis of alternate construction methods during estimating and his design of temporary works during construction of this major infrastructure facility contributed significantly to the success of the project. Clark Oglesby, a professor of civil engineering at Stanford and also an eventual NAE member, brought one of his classes to the Nimbus project on a field trip. Clark was planning to develop a graduate construction program at Stanford and encouraged John to consider joining the faculty.

As a result, John became a professor of civil engineering at Stanford in 1955 and co-founded the Construction Engineering and Management Program with Clark Oglesby. He taught at Stanford for 35 years until retirement in 1990 and served as the first Charles A. Leavell Professor of Civil Engineering. His teaching focused on planning and construction engineering for large infrastructure projects. He later developed some of the first courses focusing on application of network planning techniques in construction. With Professor Oglesby, John also obtained research support from the Bureau of Yards and Docks, U.S. Navy, in 1958. Later renewed for a total duration of eight years, this pioneering support for research in construction eventually covered many critical topics: application of operations research techniques to construction operations, development of time-lapse motion picture techniques, application of engineering economics to policy decisions concerning construction equipment, and refinement of the critical path method of scheduling construction operations. John initiated research concerning the use of short-interval time-lapse movies to analyze construction operations, developed the initial equipment and methods, and turned this work over to Professor Henry Parker when he joined the construction faculty in 1962.

John pursued multiple types of solutions to the "time-cost trade-off problem" to determine the performance rates for activities that would minimize the overall cost of a project, including indirect costs. He was recognized worldwide as a major contributor to development and use of the Critical Path Method for construction planning and project management. He developed the precedence methods of planning and scheduling, which used flow charts that represented activities as nodes of a diagram, to supplement the activity on arrow methods previously developed by DuPont and the U.S. Navy Special Project Office. The precedence method simplified the planning process and allowed the use of lag factors to begin a successor activity prior to full completion of its predecessor activities. He also investigated ways to increase use of CPM techniques in construction. His publication, *Non-Computer Approach to the Critical Path Method for the Construction Industry,* sold over 20,000 copies and was translated into over 20 languages. It provided an extremely valuable stepping stone between conventional procedures for analysis of construction plans and schedules to computer methods.

In an early example of start-up companies that grew out of research at Stanford, John and two former students founded Construction Data Systems Corporation. This firm assisted many owners and contractors in applying the new network techniques to develop detailed plans for complex infrastructure projects. John also helped found the Project Management Institute in 1969 and later served as its president and chairman. In 2007 this organization recognized his major contributions to the field as recipient of the James O'Brien Lifetime Achievement Award.

In another pioneering effort, John founded the Construction Institute at Stanford in 1960. One of the first industry affiliate programs at Stanford, this organization included progressive owners and contractors who established mutually beneficial links with the graduate construction program. The plan to found the Construction Institute envisioned a group of firms and individuals from industry who would provide financial support and counsel for further development of the construction curriculum and for research on long-range problems of the construction industry.

The Construction Institute continues today to provide highly valuable support for the Stanford construction program. The member firms provide input about current construction practices and opportunities and support teaching by industry experts focusing on key topics such as accounting, estimating, labor relations, leadership, and real estate development. This interaction with industry provides expanded educational opportunities for the students and better prepares them for careers with leading firms. John also used the Construction Institute to maintain long-term links with graduates and friends of the program and to assist them in their careers.

John taught construction management courses in Egypt, Chile, Peru, Colombia, Venezuela, Denmark, Switzerland, South Africa, Australia, and Japan, and he traveled with one of the first American groups to visit China following its opening in 1979. He served on the boards of the Scott Company and Caterpillar, Inc. He was awarded the Golden Beaver Award for Services & Supply in Heavy Engineering Construction in 1976, which he deeply cherished. John was elected to the NAE in 1993 and to the National Academy of Construction in 2001. Other recognition of his many contributions to construction included his receipt of the American Society of Civil Engineers (ASCE) Construction Management Award in 1977 and ASCE's Peurifoy Construction Research Award in 1990. John's Peurifoy Award lecture highlighted the emergence of the construction engineer as a recognized member of the civil engineering profession and the need for further actions to implement new techniques, decrease disputes and litigation, improve contractual relationships, and increase professional teamwork.

In 1965 the Fondahl family found a house in Los Altos Hills (California) with spectacular views, where they have lived ever since. John taught his daughters to place concrete and worked incessantly on projects to improve the home. He and Doris were longtime supporters of local theater groups, including Bus Barn, Theatreworks, and ACT. On special occasions, John enjoyed sharing a bottle of Ridge wine with his family and friends and was a regular Ridge visitor on Father's Day. Upon retirement he became a full-time gardener, planting and nurturing a large orchard and garden and engaging in year-round production of soups, jams, preserves, and juices. John loved hiking and cross-country skiing at Lake Tahoe, including leading his family on an annual hike up to Desolation Wilderness's Crag Lake. John and Doris enjoyed traveling together to places around the world. In 1970 he and his family joined his father on a trip to their ancestral home in Fondalen, on the Holandsfjord in Norway.

Throughout John's life the people who knew him valued his integrity, his stoicism, and his wisdom to hold his comments on matters of importance until he had reflected thoroughly on them. All who had the good fortune to know and work with John will deeply miss his reflective analysis, sage advice, realistic view of the context of construction, and unfailing sense of humor.

John is survived by Doris, his wife and companion of 70 years; daughters Lauren, Gail, Meredith, and Dorian; son-in-laws Ken Bilski, Joe Martinka, and David Wickline; and grandchildren Gwynne Bilski, Arielle Martinka, and Peter Martinka.

GERARD F. FOX

1923–2008

Elected in 1976

"For contributions in structural theory with innovative elements of construction practice in building bridges."

BY WAI-FAH CHEN AND JOHN M. KULICKI

GERARD F. FOX, an internationally recognized leader in long-span bridge design, died December 12, 2008. He was born in 1923 and graduated from LaSalle Academy.

He served three years in the Army Air Corps during World War II at Eglin Air Force Base in Florida, where he worked on a research project to develop bomb sights. After the war he attended Cornell University and graduated with distinction in civil engineering in 1948.

A licensed professional engineer, Fox was a bridge designer at Howard Needles Tammen & Bergendoff (HNTB) for 40 years, retiring in 1988, having been a partner for 21 years, responsible for bridge projects firm-wide. Prior to becoming a partner, he was chief structural engineer in the New York City Office of HNTB, directing structural design, detailing, and the preparation of plans and specifications for bridges and related structures.

Fox was in charge of the design of the longest segmental concrete cable-stayed bridge in North America—the Dames Point Bridge in Jacksonville, Florida, originally designed in both concrete and steel, with a center span of 1,300 feet, and the Rio Niteroi Bridge in Brazil, with a record steel box girder span of 984 feet. Both were awarded the American Consulting Engineers Council Grand Conceptor Award.

He also designed or supervised all types of steel and concrete bridges, including the 5.2-mile Penang Bridge, a 1,444-foot three-span segmental concrete cable-stayed bridge linking Penang Island with the mainland of Malaysia, and the Cooper River Bridge in Charleston, South Carolina, an innovative parallel chord steel truss with a span of 800 feet, among others. He served as a member of the World Bank's Design Review Panel for the Bahrain Causeway Project and as a member of the Cornell University panel to evaluate the condition of the cable system of the 1,000-foot radio telescope structure at the Arecibo Observatory in Puerto Rico. A renowned expert in bridge design, Fox continued to consult on major bridge projects for Caltrans, including the San Francisco–Oakland Bay Bridge from 1998 until 2007.

Fox pioneered the use of the computer for engineering problem solving, attending IBM schools for programming instruction and subsequently developing large-scale structural analysis and design programs to run on mainframe electronic computers. At Columbia University he taught bridge design for 20 years, using his computer applications. In 1986 he was awarded the first adjunct professor award "for outstanding contributions to the school through inspired and effective teaching."

He lectured at many other universities, including courses in bridge design at Cornell University. He was very involved in the Cornell University Alumni having served as President of the Cornell Society of Engineers (CSE), a member of the Civil and Environmental Engineering Advisory, and Director Emeritus of the Cornell Engineering Alumni Association (CEAA).

Fox was elected to membership in the National Academy of Engineering in 1976, "for contributions in structural theory with innovative elements of construction practice in building bridges." He was honored in 1980 with the American Society of Civil Engineers (ASCE) Ernest E. Howard Award, bestowed for his innovative contributions to and advancement in the design of long-span bridges. In 1986 he was awarded the ASCE Metropolitan Section's Roebling Award for eminence in design and rehabilitation of bridges. In 1987 at the International Bridge Conference, he was presented with the John A. Roebling Medal for lifetime achievement in bridge engineering. In 1999 the American Institute of Steel Construction presented him with a Lifetime Achievement Award in special recognition of his many years of exceptional service. He was an honorary member of the ASCE and the International Association of Bridge and Structural Engineers and a life member of the Structural Stability Research Council. He also served on the Committee on Steel Bridges of the Transportation Research Board.

In 1995 Fox received an honorary doctor of science from the New Jersey Institute of Technology for his engineering achievements in long-span bridge building and in appreciation of his continued dedication to advancement of the field.

Fox was often asked for his expert opinion on bridge failures, including in an article in *The New York Times* on July 15, 1983, entitled "Bridge Design Experts Discuss Issues of Safety" and on *The Today Show* in 1988. He authored a chapter on arch bridges in the *Bridge Engineering Handbook* (edited by Wai-Fah Chen and Lian Duan).

Fox's favorite pastime outside work was spending time with his children and grandchildren and surf fishing at Montauk Point. Survivors include his wife of 59 years, Jeanne McNulta, his daughters Maureen (Rodney VenJohn), Catherine (Genaro Lozano), and Elizabeth; his grandchildren, Madeline and Joseph; and siblings Grace McCabe and Donald Fox. His daughter Particia passed away in 2002.

JOHN L. GIDLEY

1924–2009

Elected in 1994

"For development of stimulation materials and techniques to increase oil and gas production."

BY ROBERT S. SCHECHTER, LARRY W. LAKE,
AND HENRY H. RACHFORD, JR.

JOHN L. GIDLEY—a creative engineer, a scientist, a man of great integrity, and a beloved family man—died on March 30, 2009, in Houston, Texas. He will be missed by all who frequently sought his wise counsel.

John was born December 30, 1924, in Lytle, Texas, a small town 25 miles southwest of San Antonio. He graduated from Lytle High School as valedictorian in 1942. After one year at Texas A&M University, he served two and one-half years in the U.S. Army Air Corps, flying B-17s, B-24s, and B-29s as pilot or co-pilot. After the war he completed his education at the University of Texas in Austin, receiving B.S., M.S., and Ph.D. degrees in chemical engineering. He was truly grateful for the education he received as a result of the G.I. Bill.

After his formal education John joined the research staff of the Humble (now Exxon-Mobil) Production Research Company in December 1954. He began his research on acidizing processes, which are oil and gas well stimulation techniques. These are designed to create flow paths through the rock surrounding a well bore drilled into a subterranean formation containing hydrocarbons. It was Herman Frasch, inventor of the method of producing sulfur by introducing hot water into sulfur-bearing formations, who first used acid to stimulate the production of oil and gas around 1900. Gidley hypothesized that acid would release fine particles as well as create preferred flow paths, so he began a study of Pickering emulsions. These emulsions of oil and water hinder flow; they are stabilized by fine particles of mixed wetability that are present at oil/water interfaces. To remove these particles from these interfaces, Gidley developed a mutual solvent that partitioned between oil and water and caused the particles to be drawn into the bulk phases, thereby destabilizing the Pickering emulsions and improving flow.

When Gidley discovered that weak acids (such as formic and acetic) reached a thermodynamic equilibrium when contacted with an excess of carbonate rock, he conceived a new process applying these acids. The Humble engineers decided to try the process on wells on Humble leases on the King Ranch, some 800,000 acres in deep South Texas. After obtaining permission from the owners of the King Ranch to test Gidley's process there, a well was drilled and Gidley was admitted to the ranch, which was surrounded by a fence and guards. He was driven to the well site, where trucks loaded with the prescribed chemicals awaited his instructions. At the well site vaqueros were busy preparing a sumptuous meal of steaks, fresh corn, and iced tea. It was, Gidley said, "a meal for kings." He noted about 50 yards from the well site about a 5-acre pasture that had obviously been watered to maintain its green texture. In this pasture resided a race horse; the vaqueros told Gidley that the horse was Assault, the great triple-crown winner who was unable to stud. He was, they said, quite friendly (or lonely). When someone approached the pasture, he would greet them to have his nose rubbed and receive any cubes of sugar they might have with them.

John said this was a most interesting field test. He later contrasted the one on the King Ranch with the test of the same process 150 miles into the Libyan Sahara that required everything—chemicals, water, food, and tools—to be transported into the desert. One must go where the oil is to conduct such tests.

The use of mutual solvents following acid treatments proved to be beneficial in improving the flow of oil into the well bore, thereby increasing the rates of oil production. Thus, it became widely applied within Exxon, and during the first three years had increased the company's daily oil production by more than 25,000 barrels. John's invention, "The Acid-Mutual Solvent Method," was patented and is still in use. He was extremely pleased that royalties collected from his patents by Exxon's research affiliate more than paid his salary and benefits during the last 17 years of his 28-year employment with Exxon.

In 1975 John convinced Exxon to conduct a field test of a new experimental material, sintered bauxite, as a high-strength proppant to keep the fractures open following hydraulic fracturing. Designed in collaboration with co-worker Claude Cooke, Jr., the test resulted in a major improvement in hydraulic fracturing. This new proppant, first in a whole series of ceramic proppants, extended the depth of reservoir stimulation by hydraulic fracturing from less than 10,000 feet to more than 20,000 feet.

Gidley spent the first 13 years in the laboratory and was then transferred to the headquarters group, where he was put in charge of the schools Exxon conducted for new engineers. During this time he never stopped working on well stimulation technology. From 1969 to 1986 he chaired the American Petroleum Institute (API) Subcommittee on Well Completion and initiated the committee effort that resulted in six API documents on recommended practices for testing and evaluation of well stimulation. He also chaired the Task Group on High Temperature Cements (1971–1979) and API Standardization Committee, Subcommittee 10, on Oil Well Cements (1969–1979). John was also active in the Society of Petroleum Engineers (SPE). He served as editor in chief of the 452-page monograph *Recent Advances in Hydraulic Fracturing,* published by the SPE in 1990. Written by 23 authors, the book sold 4,955 copies by August 1997. Altogether, throughout his career, he also authored or co-authored 25 published technical papers.

When Gidley retired from Exxon in 1986, he continued to be active professionally. He formed a consulting company and decided to follow up on some of his ideas. One of these was his conjecture that results would be improved if, before treating wells completed in sandstone formations with hydrofluoric acid, the wells were first flushed with carbon dioxide. The goal was to remove both the oil and the water from the formation surrounding the well bore before it was acidized. Gidley invited several oil companies to participate in tests. The idea was that each company would identify a well, pay the cost of the test, and at the end of the program receive a report that would summarize the results of all the tests performed. Because Gidley was well respected for his previous accomplishments—he was elected to the National Academy of Engineering in 1994 and received the SPE's John Franklin Carl Award in 1992 as well as honorary membership, its highest award—he almost immediately found more than a dozen companies willing to sponsor the test. As he promised, the tests were completed in rapid-fire order and the report was issued. In Gidley's estimation the results were positive and formed the basis for a patent application—his ninth.

Gidley was then invited to teach well stimulation at Texas A&M, which he did between 1993 and 1999. He loved the classroom and working with graduate students; he found this activity immensely rewarding. In 1999 the University of Texas at Austin named him a Distinguished Engineering Graduate. He was also a member of the Chancellor's Council of the University of Texas System. He was honored in October 1990 by being named Distinguished Member of the SPE. In addition, he was designated as Distinguished Lecturer by the SPE (September 1979 to September 1980). He was also a member of several national honor societies: Tau Beta Pi (engineering), Phi Lambda Upsilon (chemistry), Omega Chi Epsilon (chemical engineering), and Sigma X (research).

Gidley more fully retired in 2000, although he still provided his consulting services when requested. He developed a model to calculate the flow of gas within a hydrochloric-acid-induced fracture. Since the flow of gas in fractures is turbulent, Gidley's correction is necessary to calculate gas production through hydraulic fractures correctly. John Gidley was intrigued by complex processes that defied mathematical prediction. His laboratory was often found in nature, as he frequently resorted to experiments there.

In addition to his stellar professional life, John was a devoted father and grandfather, sponsoring an annual family reunion known as Gidleyfest at locations throughout the United States. He was active as a cub master for Cub Scouts Pack 280 at Holy Ghost Catholic Parish and School. A convert to the Roman Catholic faith, he served as a lector at Holy Rosary Catholic Church in Houston.

John supported many charitable causes and helped endow new student scholarship funds at Spring Hill College, the debate program at the University of Kansas, and the University of Texas School of Engineering. In addition to his enjoyment of teaching and stressing the importance of education, he had a lively sense of humor and was well known for his warmth, for his humility, and for making people feel at ease.

It truly can be said that John Gidley's life was a treasure for all of us who had the good fortune to know him.

Dr. Gidley was preceded in death by his wife Betty Jane Boggus and infant son, his brother Jack Gidley, and his sisters Jane Kenagy and Betsy Shaw. He is survived by his wife Virginia Anne Platz, his children Michael Andrew Gidley, John Mark Gidley (Bridget), Carol Gidley Wright (Charlie), Dr. Paul William Gidley (Milvia), Brian David Gidley, Allyson Anne Morrison (Richard), and Neil P. Gidley (Maggie), and his sister Margaret Clover and brother William J. Gidley, and his grandchildren Danielle Gidley, George Franklin Gidley, Travis Gidley, Jessica Gidley, Jack Gidley, Edward Gidley, Elizabeth Gidley, Charlotte Gidley, Eliza and Dalton Wright, Gabriel Gidley, Haley Morrison, Austin Morrison, John Lytle Morrison, Julia Morrison, Lauren Morrison, and Colin Patrick Gidley.

JOHN J. GILMAN

1925–2009

Elected in 1975

"For contributions to dislocation behavior of ceramics, disclination behavior of polymers, leadership in development and production of metal glasses."

BY JOHN D. MACKENZIE

JOHN JOSEPH (JACK) GILMAN, adjunct professor with the Department of Materials Science and Engineering, Henry Samueli School of Engineering and Applied Science, University of California, Los Angeles (UCLA), passed away on September 10, 2009, at the age of 83.

Jack Gilman was indisputably one of the most renowned materials scientists in the world in the field of mechanical properties of solids. He was born on December 22, 1925, in Green Bay, Wisconsin. He received his B.S. in mechanical engineering in 1946 and his M.S. in 1948, both from the Illinois Institute of Technology. He then proceeded to Columbia University where he received a Ph.D. in physical metallurgy in 1952. After a short stay at the Crucible Steel Company of America where he did research on steels, he joined the General Electric Research Laboratory in Schenectady, New York, in 1952. There he was given total freedom to study the mechanical properties and structure of single crystals.

Jack made good use of his freedom and his talents and started a fundamental research program on dislocations and their role in the deformation of solids. His collaboration with W. G. Johnston and others at General Electric resulted in many publications on dislocations in highly respected journals, such as *Philosophical Magazine* and the *Journal of Applied Physics,* and earned him worldwide recognition as "Mr. Dislocations." He stayed at General Electric until 1960, leaving to become a professor of engineering at Brown University. In 1963 he transferred to the University of Illinois to become professor of physics and metallurgy. After five years, Gilman left academia and joined the Allied Chemical Corporation as director of the Materials Research Center. At Allied Chemical he made significant contributions to the development and application of metallic glasses. He became director of the Corporate Development Center at Allied Chemical in 1978, leaving in 1980 to become manager of corporate research at Standard Oil Company in Indiana. From 1981 to 1985 he was vice president and director of the Amoco Battery Technology Company. From management of industrial research, Jack moved West in 1985 to become director of the Center for Advanced Materials at the Lawrence Berkeley Laboratory at the University of California in Berkeley. Two years later, after two decades in administrative and management positions in industry and academia, Jack Gilman returned to his first love—fundamental research in materials science. He stayed on at the Lawrence Berkeley Laboratory as a senior scientist, studying the relation between crystalline structure and mechanical properties of solids. In 1993 he joined the Department of Materials Science and Engineering at UCLA as an adjunct professor.

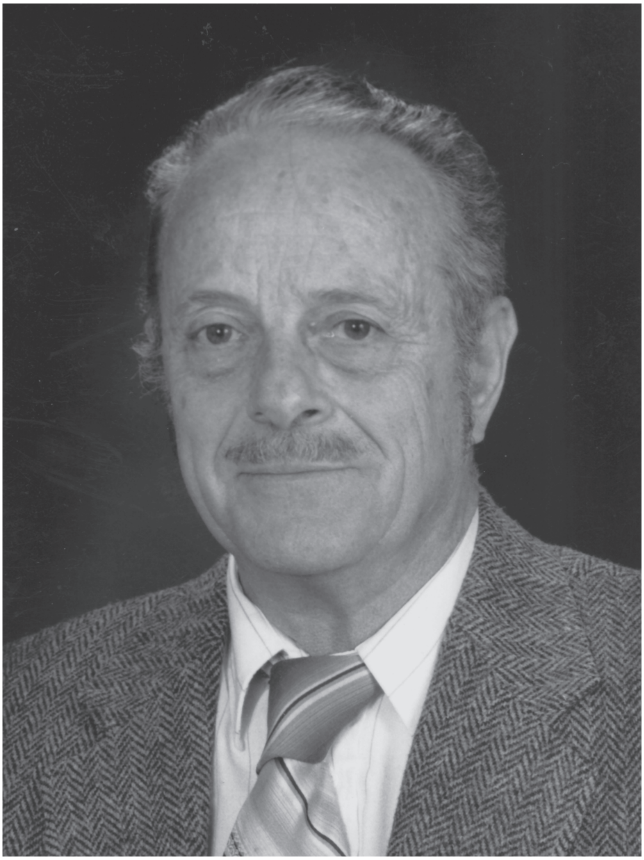
Professor Gilman was a remarkable person not only for his great contributions to scientific understanding of the mechanical properties of all types of materials but also for his ability to successfully manage industrial research and perform outstanding individual research simultaneously. He had continued to contribute scientific papers based on his own theoretical research on materials science while he was a senior manager in industry. And he was publishing papers on management as well! He published over 330 papers of which 73 are on industrial management. Some examples of these papers are: "What Do Good Research Organizations and Good Jazz Combos Have in Common?" (*Material Technology,* vol. 11, pp. 70-72, 1996); "Six Management Routes to More Productive Research" (*Material Technology,* vol. 9, pp. 129-131, 1994); and

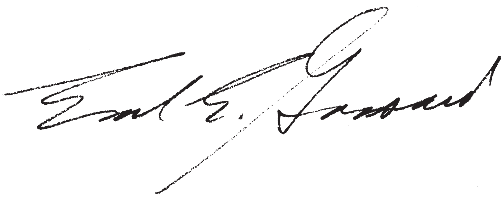
"Top-Down or Bottom-Up Research Management" (*R&D Innovator,* vol. 4, pp. 1-4, 1995). His other 257 publications are all on "pure" science and all are first-class works. The topics include metals, ceramics, glasses, semiconductors, polymers, and diamond and nano-materials. There is even an interesting paper entitled "Strength of Spider Silk" (*Science,* vol. 272, no. 17, 1996). To Jack Gilman there was no impenetrable boundary to scientific understanding of the relationship between structure and mechanical properties of any class of materials. In recent years he devoted some of his talents to the preparation of new super-hard materials such as osmium diboride. In addition to all his publications in many prestigious journals, Jack Gilman was editor and co-editor of three books and the author of four. His research also resulted in the award of five U.S. patents and one British patent.

For all his contributions, Professor Gilman received many honors and recognitions worldwide. He was awarded the C. H. Mathewson Gold Medal of the AIME in 1959 and the A. H. Geisler Award of the ASM in 1957. He was elected a fellow of the American Physical Society in 1969, a fellow of the American Society for Metals in 1971, and a member of the National Academy of Engineering in 1975. He was a principal invited lecturer in Moscow in 1958; in Melbourne, Australia, in 1959; in Cambridge and London, in 1960; in Tokyo in 1962; in Goettingen, Germany, in 1964; in Sendai, Japan, in 1965; in Torino, Italy, in 1967; in Beer Sheva, Israel, in 1972; in Warsaw, Poland, in 1972; in Paris in 1972; in Beijing in 1975; in Zurich in 1976; and again in Tokyo in 1988. He served on many committees of the National Research Council, including the Committee on Ship Steel (1962–1963), the Committee of the Materials Advisory Board on High Strength Materials (1964–1966), and the Solid State Sciences Committee (1978–1982) .

Despite all the honors he received, all of his contributions to materials science and research management in industry, as shown by his over 330 publications and his books, Jack Gilman was always a quietly modest man with a ready smile. As an adjunct professor of our department at UCLA for 16 years, he continued his theoretical research to the very end. In addition to our pride of having him as a colleague, he is best remembered as that senior professor who always sat in the front row at all our departmental seminars every Friday and asked every lecturer the most penetrating questions. Many students informed me that Professor Gilman's questions for the seminar speakers and the resultant discussions were the best education they had received in materials science. We at UCLA will miss him and the materials science and engineering community worldwide will miss his brilliant theoretical research.

He is survived by his children, Pamela, Gregory, Cheryl and Brian; as well as his stepchildren, Kathy, John and Nicholas.





EARL E. GOSSARD

1923–2009

Elected in 1990

"For fundamental advances in understanding the interactions between radiowaves and the atmosphere and major developments in remote sensing."

BY RICHARD G. STRAUCH

EARL E. GOSSARD, renowned atmospheric scientist, died on January 27, 2009, at his home in Fortuna, California, at the age of 86. He retired in 1999 after a distinguished career, primarily at the National Oceanic and Atmospheric Administration's Wave Propagation Laboratory (WPL). He was elected to the National Academy of Engineering (NAE) in 1990.

Earl was born on January 8, 1923, in Eureka, California. He had an early appreciation of, and a fascination with, the world around him. He spent time roaming the hills and valleys of his boyhood home on foot or on horseback. He married his life companion, Sophia (Marge) Poignand, on November 21, 1948.

After serving in the U.S. Army Air Force from 1943 to 1946 as a first lieutenant, Earl attended Humboldt State University in Arcata, California. He received his B.A. degree from the University of California at Los Angeles (UCLA) in 1948 and his M.A. degree from the University of California at San Diego in 1951. He earned his Ph.D. in physical oceanography in 1956 from UCLA for research conducted at the Scripps Institution of Oceanography, where he worked with Walter Munk on atmospheric gravity waves. His Ph.D. thesis was titled "Gravity Waves in the Lower Troposphere Over Southern California."

Concurrent with his studies, Earl began his professional career as a meteorologist at the Naval Electronics Laboratory (NEL) in San Diego in 1951. He became head of the Radio Meteorology Section in 1955, and from 1961 to 1971 he was head of the Radio Physics Division at NEL (later the Naval Ocean Systems Center). In 1971 he joined WPL in Boulder, Colorado, as chief of the geoacoustics program. From 1973 to 1982 he was chief of the meteorological radar program at WPL. In 1982 Earl was appointed senior research associate at the Cooperative Institute for Research in Environmental Science at the University of Colorado, Boulder. From 1997 until his retirement in 1999, he was a senior scientist with the Science and Technology Corporation.

Early in his career at NEL Earl published several foundational papers describing the structure of the marine boundary layer and associated propagation and scattering effects relevant to over-water communications. He received the Distinguished Research Award at NEL in 1971. At WPL he published widely in all aspects of atmospheric structure, propagation, and scattering related to ground-based remote sensing of atmospheric variables. He was the senior co-author of two classic atmospheric science texts: *Waves in the Atmosphere* (with W. H. Hooke, 1973) and *Radar Observations of Clear Air and Clouds* (with R. G. Strauch, 1983). As a result, he received the U.S. Department of Commerce (DOC) Distinguished Author Award in 1975 and again in 1985.

He was author or co-author of more than 100 open-literature publications spanning five decades of research (publishing in each of six decades from the 1950s through 2000s). He was an invited author of a chapter, "Radar Research in the Atmospheric Boundary Layer," in the 40th anniversary volume of *Radar Meteorology,* published by the American Meteorological Society (AMS). He served as co-editor of a special issue of Radio Science on radar investigations of clear air in 1980. He delivered more than 30 invited presentations at national and international symposia. He received a DOC Special Achievement Award in 1974, a DOC Unit Citation as chief of the Meteorological Radar Program in 1975, and the DOC Silver Medal in 1977. He holds a patent (with others) on a modification of the Navy's OMEGA navigation system.

Dr. Gossard was a member of Commissions F and G of the International Radio Scientific Union (URSI) and was a chairman of Commission F for the United States. He served as a member of the URSI National Committee and as a consultant to the Interunion Committee on Radio Meteorology. He was a member of the American Geophysical Union. In 1990 he became a fellow of the AMS and was elected to the NAE.

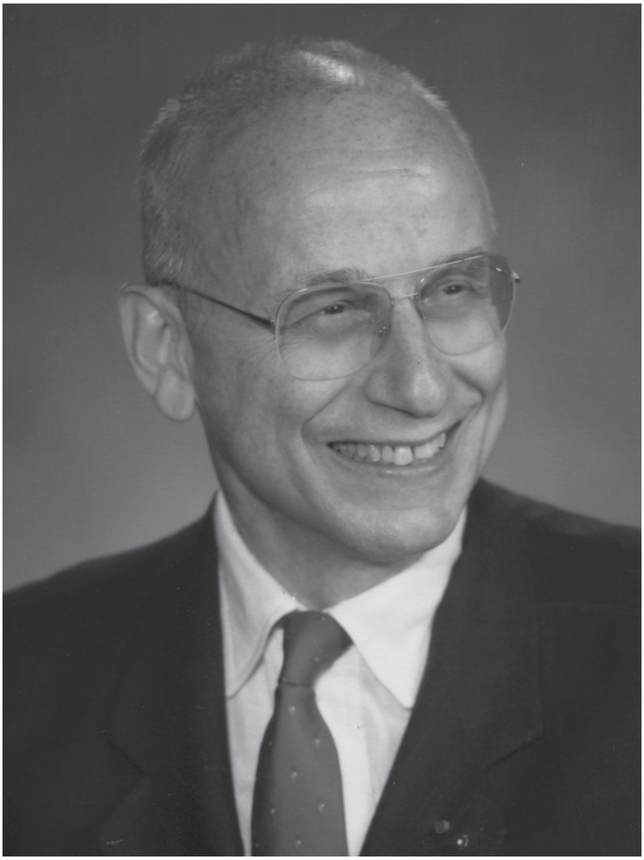
All who knew Earl in his professional life recognized a true gentleman and a gentle man. He generously gave credit to his co-workers. He began his career when paper, pencil, and intellect were the tools of the scientist. and when technological advances brought new tools he used them in data analysis but never as a substitute for reason. His reputation for using an experimental data set to verify the underlying scientific theory was legendary.

It was apparent to all that Marge, his life companion, was an integral part of his daily life. No group meeting was allowed to last into the noon hour because Marge made the drive from their mountain home to join him for lunch, regardless of the weather. She was always with him when he traveled to meetings and conferences worldwide. More important to him than all his career achievements was that Earl, known to his family as Bud, was a dedicated and loving husband, father, grandfather, and great-grandfather. In 2003 he moved from Boulder to the Humboldt County, California, redwood area of his childhood that he so loved.

Earl is survived by his wife of 60 years, Sophia (Marge) Poignand; children Linda Gossard (of Longmont, Colorado), Ken Gossard (of Mattole, California), and Diane Warn (of Waiheke Island, New Zealand); and five grandchildren and six great-grandchildren. Grateful acknowledgment is made to granddaughter Heather Brown for sharing her special tribute to her grandfather.

His daughter, Linda Gossard, wrote:

> When I remember my father, I think of his insatiable curiosity about everything in life. He taught us children how to love "finding answers" to our questions. I remember when I was about 12 years old being very interested in his family's genealogy. My father gave me some books to read on the history of Humboldt County and got me in contact with my uncle who knew more about his family's history than anyone else. The next summer my father "trailered" my horse up with us to the family ranch so I could spend that summer riding on the trails, so full of history, that he had ridden when he was a young boy. It has been one of the most memorable experiences of my life.
>
> Whenever I remember my father, I will always think of the phrase "love of learing" and that great gift he gave us.



SERGE GRATCH

1921–2007

Elected in 1983

"For contributions to the thermodynamic properties of gases, development of successful automotive exhaust control systems, and utilization of alternative fuels."

BY JULIUS J. HARWOOD

SERGE GRATCH, a much-honored member of the engineering profession, died December 4, 2007, at the age of 86. His career achievements and honors reflect a life of dedication and commitment to the advancement, innovative capabilities, and high standards of the engineering profession. His career spanned more than five decades in scientific research, in engineering developments, in research and development technical management, and as a university professor. He made distinguished contributions to such diverse fields as thermodynamic properties of gases, polymer science and synthesis, successful automotive exhaust control systems, alternate fuels, and engineering education. In the decade prior to his death, he retired first from the Ford Motor Research laboratory as director of Vehicle, Powertrain and Component Research and subsequently as professor emeritus from Kettering University (formerly GMI—General Motors Engineering and Management Institute).

Serge was born on May 2, 1921, in Monte San Pietro (Bologna), Italy. His father was a country doctor, and his mother was a homemaker with a degree in chemistry from the University of Bologna. He originally studied pre-med, but in 1939 Serge and his family emigrated to the United States to escape from the growing power and tyranny of the Fascist party. He became a naturalized U.S. citizen on February 21, 1945.

He enrolled at the University of Pennsylvania and received his bachelor's degree in chemical engineering (1942), followed by a master's degree (1945) and doctorate in mechanical engineering (1950). For the year following his Ph.D., he was an assistant professor at the University of Pennsylvania. In the early 1940s he had worked as a laboratory assistant under Professor John Goff, then dean of the Towne Scientific School, with whom he developed a formulation of the thermodynamic properties of moist air that was adopted in 1947 as an international standard and retained that status for more than 30 years.

Serge joined Rohm & Haas Company as a senior research scientist in 1951. Among the broad range of studies he carried out there was the discovery (with a colleague T. G. Fox) of crystallizable polymethyl methacrylate, which led to a successful application market in the automotive industry.

In 1959 he again turned to academia as an associate professor in mechanical engineering at Northwestern University.

Serge made his next move in 1961, accepting a position in research management in the scientific laboratory of Ford Motor Company. His "tenure" at Ford lasted until 1986, when he retired. During that 25-year period, he was engaged in directing a variety of research departments involving chemical processes and devices, electrical and electronic devices, fuel sciences, polymer sciences, and chemical and materials science research, and he eventually became director of Vehicle, Powertrain and Component Research—a tribute to his broad range of technical expertise and interests.

The 1970s were turbulent times for the U.S. automotive industry, with the introduction of governmental requirements for emissions control and fuel economy standards. Serge Gratch played a key role in these areas, directing the Ford research programs on engine exhaust catalysts and being responsible for coordinating Ford's worldwide research and development activities in this area. He also initiated a Ford program on alternate fuels (having previously initiated and led the company's electric car research program in the 1960s). Serge often was called to testify before various governmental bodies on matters of concern to Ford in these and related areas.

As a personal aside, Serge and I joined Ford within a year of each other, and we both retired from Ford in the early 1980s. During that period it was our privilege and pride for the Ford Research Laboratory to develop into one of the nation's outstanding industrial research laboratories, with a worldwide reputation for the contributions of the talented cadre of scientists and engineers who joined the laboratory. We aspired to fulfill the vision of Henry Ford II to create a "Bell Laboratory of the automotive industry." It was a most stimulating and exciting professional experience.

Closely coupled with Serge's busy work schedule was his deep commitment to service for the professional engineering societies. He joined the American Society of Mechanical Engineers (ASME) in 1944 and, over the ensuing years, participated in numerous technical and policy committees. To cite a few, he served on the ASME Committee on Honors, the Policy Board, the Board of Governors, and the Board of Trustees of the ASME Foundation and he served as president of ASME from 1982 to 1983. A long-lasting contribution was his chairmanship of the ASME Committee on Planning and Organization; he helped implement the recommended new organization structure as president of ASME. He was elected a Fellow of ASME in 1968 and became an Honorary Member in 1980. A proponent of expanding technological literacy into liberal arts education, Serge's inaugural address as ASME president called for a new breed of engineer, committed to lifelong learning, whose education and knowledge would cut across the traditional engineering and scientific disciplines. I am tempted to write that there may not have been a major activity of ASME that did not carry the brand of Serge Gratch in some way.

Serge also was active in the Engineering Society of Detroit and the Society of Automotive Engineers, becoming a Fellow of both organizations, and he also was an active member in the American Association for the Advancement of Science. Both the Coordinating Research Council and the Automobile Manufacturers Association relied on his expertise on alternate fuels, combustion research, and air pollution studies.

In 1979 Serge was appointed by President Carter to membership on the National Alcohol Fuels Commission. He was a member of the National Materials Advisory Board and served on various study committees of the National Research Council.

As might be expected, Serge also served on several academic advisory committees, including for his alma mater, the University of Pennsylvania.

Serge Gratch's accomplishments and recognition yielded numerous honors and awards, including the University of Pennsylvania's Alumni Award of Merit and its D. Robert Yarnell Award, the Outstanding Leadership Award (twice) from the Engineering Society of Detroit, the Outstanding Teaching Award from Kettering University/GMI, and the ASME Internal Combustion Award. He also was the recipient of two of the highest awards in the engineering community: in 1983 he was elected to the National Academy of Engineering, and in 1992 he received the John Fritz Medal from the American Association of Engineering Societies (for scientific or industrial achievement in any field of pure or applied science).

Serge closed his career by returning to where he had started: academia. He became a professor of mechanical engineering at Kettering University and took special delight in teaching and motivating the young minds of future engineers.

Serge is survived by his wife of 57 years, the former Rosemary A. Delay, and their 10 children and 13 grandchildren, two of whom are adopted—processes that were begun before Serge's death, but which dreams he did not get to see come true. He often was teased by his colleagues for his contribution to the feminist movement with the biased distribution of his nine daughters and one son.

Serge Gratch led a busy and productive life dedicated to the teaching and application of science and technology for national and industrial betterment, combined with a deep commitment to his family and the service of the engineering profession, his government, and his students.

WILLIAM A. GRIFFITH

1922–2009

Elected in 1998

"For technical contributions in the mining industry leading to new technology for optimal resource utilization and enhanced productivity."

BY TERRY MCNULTY

WILLIAM A. ("BILL") GRIFFITH, a retired mining industry executive, was elected to the National Academy of Engineering (Sections 8 and 11) in 1998 and died on April 30, 2009.

Bill was born on March 28, 1922, in Sioux Falls, South Dakota, and was raised in the Sioux Falls area, graduating from Canton High School in 1940. His education was interrupted by service in the U.S. Navy (Amphibious Forces) during World War II. He participated in the invasions and occupations of Iwo Jima and Okinawa and in the initial landing of U.S. occupation forces in Japan. He was honorably discharged from active duty service in 1945 as a lieutenant (serving in the Naval Reserve until 1954) and resumed pursuit of a college education at the South Dakota School of Mines and Technology, receiving a B.S. in metallurgical engineering in 1947. He then studied at the Massachusetts Institute of Technology and was awarded an M.S. in metallurgy in 1950.

Bill worked as a research investigator for the New Jersey Zinc Company and as a metallurgist for Rare Metals Corporation of America during the 1950s, prior to serving as research director for Phelps Dodge Corporation (Morenci Division) for 10 years. He then joined Hecla Mining Company and held a succession of positions ranging from research director to chairman and chief executive officer. Under his leadership, Hecla rose from near-insolvency to become the premier domestic silver producer. Following retirement in 1986, Bill remained on Hecla's board of directors until 1996.

Bill was an outstanding metallurgist and manager. In the mid-1970s the direction of his research work turned to the Lakeshore joint venture owned by Hecla and El Paso Natural Gas. Copper ores from the underground mine were treated separately, the sulfides being concentrated by flotation. The copper sulfide concentrates were then roasted, enabling production of sulfuric acid from the roaster gases. The roasted calcine was blended with oxide ore, leached with sulfuric acid, and the leach liquors were treated by direct electrowinning to yield cathodically deposited copper. For a few years, magnetite was recovered from the flotation tailings, pyrometallurgically reduced to metallic iron, and applied to the precipitation of residual soluble copper from the electrowinning plant. Bill once commented that bringing this large complex operation into production was "tantamount to starting a perpetual motion machine."

Bill received an honorary professional degree from Montana College of Mineral Science and Technology, an honorary doctor of business administration from the South Dakota School of Mines and Technology, and an honorary doctor of science from the University of Idaho. From the American Institute of Mining, Metallurgical, and Petroleum Engineers, he received the Extractive Metallurgy Technology Award (1976), the A. M. Gaudin Award (1976), the Distinguished Member Award (1977), the Robert H. Richards Award (1981), and was elected to the Legion of Honor (1983).

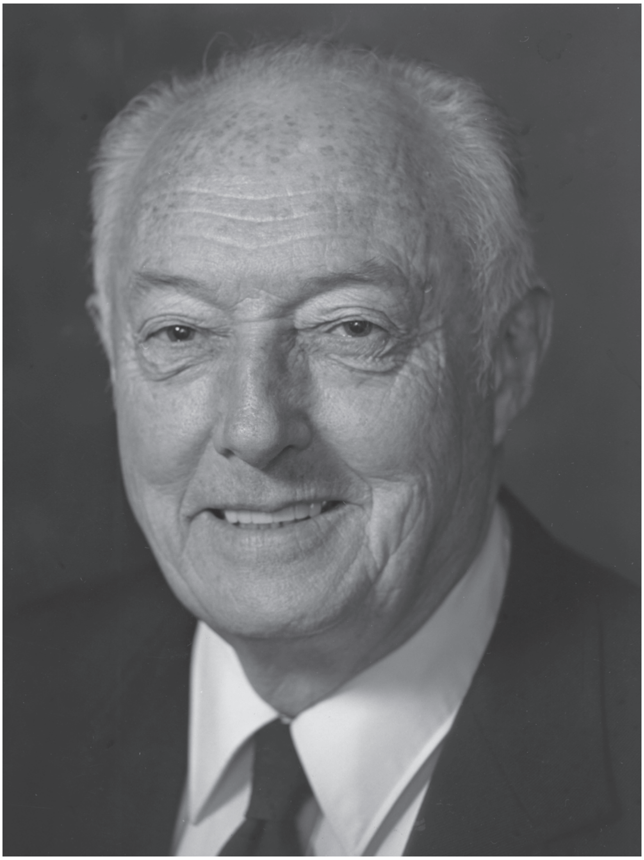
Bill was active in his community of Coeur d'Alene, Idaho, and belonged to the Rotary Club and St. Luke's Episcopal Church. He served as the director of the Idaho Association of Commerce and Industry, and of the American Mining Congress, as president of the Silver Institute and of the Western Regional Council, and was founding chairman of the board for Inland Northwest Bank. He was a humorous and caring man who left behind many good friends and respectful colleagues.

Bill married Gratia Frances Hannan on Jan. 27, 1949, in Boston, Mass. They had three children, Georgeanne Griffith of Rathdrum, Idaho; Jim (Pam) Griffith of Canton, Ohio; and

Wade (Kathleen) Griffith of Spokane, Washington. In addition to his wife and children, Bill is survived by his sister, Kate Kurvink, of Sarnia, Ontario, Canada. and devoted friend, Kathie Wilson of Coeur d'Alene. He is also survived by four grandchildren: Jennifer Griffith Weber (Josh), Wm. Ashley Griffith (Liz), Camie Griffith Rodan (Mike), and Daniel Griffith, and four great grandchildren.

Bill's wife wrote that:

> When it was time to talk about a marker for Bill's grave, his younger son said it should read: Husband, Father, Engineer, Servant, which was remarkably perceptive. His children remember him as always having exacting standards in everything he did and reminding them to always leave a place better than they found it. He was ever supportive of the interests and activities of his family—Boy Scouts (Troop Leader for two years), girls' softball, football and track events, music programs, and family picnics at Juan Miller Campground in the White Mountains of Arizona on Sundays. And the needs of the community—Rotary Club (President for the Morenci, AZ, club), vestry member and substitute organist of his church, and he loved to brag about being instrumental in changing the ratio of registered Democrats to Republicans from 16 to 1 to 14 to 1 while serving as Chairman of the Republican Party for Greenlee County, Arizona.
>
> After retirement to Coeur d'Alene, Idaho, he served on the hospital's foundation board, as well as a number of civic committees, and was dedicated to working to improve education in the state, yet still found time to putter in his greenhouse, raising tomatoes and marigolds for the garden. Toward the end of his life he continued to read the Wall Street Journal regularly and study the Bible, while holding Marcello, the three-legged Siamese cat, on his lap. He also always enjoyed a spirited conversation about any controversial issue. Somehow he never found time for golf, but did enjoy playing tennis, some cross-country skiing, and a bit of bridge.



WILLIAM T. HAMILTON

1917–2002

Elected in 1978

"For contributions to the aerodynamic development of jet transports."

BY JOHN WARNER AND PHIL CONDIT

BILL HAMILTON passed away on February 16, 2002, in Tacoma, Washington. His colleagues at Boeing affectionately noted that the W and T stood for Wind Tunnel, in recognition of his prowess as an aerodynamicist. This was to distinguish him from another Boeing engineer, William L. Hamilton, an accomplished engineering leader known as "Water Line" Hamilton. "Wind Tunnel" Hamilton was known to his colleagues as "Hammy."

Born in 1917 in Pennsylvania, Hamilton grew up in Mt. Vernon, Washington. As a young boy he demonstrated an extraordinary aptitude for the principles of flight by building box kites. To test the capability of one box kite, he and a friend sent a neighbor's small dog into the air. It landed safely, as did a kite that carried a lantern.

He earned his bachelor's degree in engineering from the University of Washington in 1941. His first engineering job was at the National Advisory Committee for Aeronautics (the forerunner of the National Aeronautics and Space Administration, NASA) wind tunnel at Moffett Field, California, where he tested almost every new military plane designed during World War II. He worked out aerodynamic kinks in what became the nation's premier fighter, the P-51. After going back to the University of Washington for his master's degree, Hamilton accepted a job at Boeing in 1948, where business was in decline following the war.

During his 32-year tenure at Boeing, Hamilton worked on many of the company's top programs, from the B-52 bomber to the 767 jetliner. His best-known engineering achievements came in the area of wing design, particularly on the company's longtime workhorse airliner, the 707. His successful wing design for an enlarged 707 enabled Boeing to compete against the Douglas DC-8. Hamilton managed Boeing's supersonic transport program, where he made a major contribution by simplifying the wing design.

During the 1970s, Hamilton was vice president and general manager of the Aerospace Group's Research and Engineering Division, where he was responsible for planning and execution of all the company's technical and advanced product development. He made significant contributions to Boeing's space shuttle design, IUS, YC-14, and the Large Space Telescope, now the successful Hubble Space Telescope. In 1974 he was designated a vice president of the Boeing Aerospace Company and later ran research and development for the Boeing Commercial Airplane Company.

Hamilton was a fellow of the American Institute of Aeronautics and Astronautics and a member of the NASA Aeronautics Advisory Committee, the Defense Intelligence Agency's Scientific Advisory Committee, and the Atlantic Groups Aerospace Research and Development Flight Mechanics Panel. He was inducted into the National Academy of Engineering in 1978 for "contributions to the aerodynamic development of jet transports." He served on the Panel on Constraints in Space Shuttle Launch Rates in 1982 and the Panel on Atmospheric Vehicle Technology in 1987.

"What's the good word?" and "Small matter" were expressions employed commonly by Bill and which reflected his naturally optimistic and nearly unflappable nature. His wise and genial bearing was a constant source of strength and comfort to his family. Little known by his peers, his dream of becoming a professional Disney cartoonist gave way to his passion for aerodynamics. His skill as an artist is still evident in drawings given to friends and family over the years.

Devoted to his wife and children, he shared with them his love of nature and the outdoors on frequent camping trips and other adventures. In his earlier years he was an avid mountain climber, scaling most of the major peaks in Washington's Cascade Mountains. Fishing was another favorite pastime for him. The family kept a beachfront weekend and summer home, and plenty of boats—from dinghy to cabin cruiser.

A genuine fan of sports, and having been active in track events in his youth, he and his wife rarely missed attending University of Washington football games, both having attended school there where they met on a blind date, marrying in October of 1941.

He is survived by his wife, Ida Mae of Tacoma, Washington; a son, Richard of Copalis Beach, Grays Harbor County; daughters Janet of Portland and Nancy of Tacoma; and a grandson Chris of Tacoma.


Howard L. Hartman

HOWARD L. HARTMAN

1924–2002

Elected in 1994

"For the engineering design, codification, and practice of mine ventilation and air conditioning."

BY RAJA V. RAMANI AND JAN M. MUTMANSKY

HOWARD HARTMAN is a familiar name to over five decades of mining engineers through his authoritative text, *Mine Ventilation and Air Conditioning* (Ronald Press, 1961). Howard dedicated the first edition of the book to George McElroy, Ray Mancha, and John Warren, whom he termed modern giants of mine ventilation. Here we recognize Howard Hartman as a worthy addition to this illustrious list, and we take this opportunity to provide a brief background of his outstanding career.

Born in Indianapolis, Indiana, on August 7, 1924, Howard received his primary and secondary school education in Indianapolis. He then began his college education at the Colorado School of Mines in 1942 but joined the U.S. Navy in 1944. He received his B.S. and M.S. degrees from the Pennsylvania State University in 1946 and 1947 and his Ph.D. from the University of Minnesota in 1953, all in mining engineering. Howard was a registered professional engineer in the states of Colorado and Pennsylvania. In the years 1948 through 1950, he worked for Phelps Dodge Corporation in Bisbee, Arizona, and for the Arizona Mine Inspector's Office in Phoenix.

Howard embarked on an academic career of over four decades as an instructor in mining engineering at Penn State in 1947. After earning his Ph.D., he returned to the Colorado School of Mines as an assistant professor and quickly rose to the rank of associate professor and then became Acting Head of the Department of Mining Engineering. In 1957 he went back to Penn State as Professor and Head of the Department of Mining Engineering. Between 1963 and 1980, Howard held the titles of Associate Dean of the College of Engineering at Penn State (1963–1967); Dean of the School of Engineering, California State University, Sacramento (1967–1971); and Dean of the School of Engineering, Vanderbilt University (1971–1980). In all these assignments, Howard was an innovator, creating the first work-study program in mining engineering at Penn State and helping to establish the new program in socioengineering at California State University, Sacramento, and the technology and public policy program at Vanderbilt. He joined the University of Alabama in 1980 as the first holder of the Garry Neil Drummond Endowed Chair in Mining Engineering, retiring in 1989 with an emeritus title.

Continuing his academic endeavors well into his retirement, Howard edited the monumental *Mining Engineering Handbook* (Society for Mining, Metallurgy & Exploration [SME], 1992) over a period of five years. As senior editor, he coordinated the efforts of six co-editors, 20 section editors, and 242 authors, producing a two-volume, 2,300-page, highly referenced handbook for mining engineers worldwide. He was also lead author and editor of the third edition of *Mine Ventilation and Air Conditioning* (John Wiley & Sons, 1997), which he originally authored in 1961. He then worked on the revision of his 1982 text, *Introductory Mining Engineering* (John Wiley & Sons, 2002) until his death in 2002 from the effects of Parkinson's disease. These texts reveal Howard's attention to the details of science, engineering, and technology and his dedication to solved examples, mind-broadening exercises, and references for further study and research.

Students' needs, particularly support for their education, were never far from Howard's mind. He established the

Howard Hartman Honor Scholarship Fund in Mining Engineering at Penn State, which benefits students to this day from the royalties on his mine ventilation texts.

Howard did pioneering research in the areas of rock mechanics, ventilation, rapid excavation, and drilling and served as a consultant to a number of mining and drilling companies and government agencies. During his distinguished career, he advised 28 students to advanced degrees, including eight who received the Ph.D. He organized the first symposiums in the United States in rock mechanics, rapid excavation, surface mining, technology and public policy, and mine ventilation through SME. He was an author or editor of over 100 papers, books, and symposium proceedings.

Howard was appointed Chairman of the Federal Metal and Nonmetallic Mine Safety Board of Review (1971–1975) by President Nixon. He was also a member of the National Academy of Sciences Committee on Tunneling Technology from 1974 to 1977. He visited many universities around the country and abroad to lecture on mine ventilation, rock mechanics, and tunneling and was recognized in *Who's Who in America* (1964).

Numerous awards for his distinguished contributions to the science and technology of mining engineering were presented to Howard. He received the American Institute of Mining, Metallurgical, and Petroleum Engineers Mineral Industry Education Award in 1965 and the Canadian Institute of Mining and Metallurgy's Distinguished Lecturer Award in Rock Mechanics in 1966. He won several prestigious awards from the SME, including the Distinguished Member Award (1982), the Daniel Jackling Award (1990), and the Howard Eavenson Award (1993). In 1989, SME created the Howard L. Hartman Award to honor Howard and to recognize individuals who have made outstanding contributions to the field of mine ventilation. He was the first recipient of the award. In 1994 Howard was elected to the National Academy of Engineering, a distinction accorded to few engineers and scientists to recognize their contributions to the advancement of engineering sciences and technology.

During his student days at Penn State, Howard met a fellow student, Bonnie Lee Sherrill, a home economics major from Bentleyville, Pennsylvania. Ever since their marriage in 1947, Bonnie has been the number one supporter of Howard, and her contributions to his professional endeavors were enormous. Howard and Bonnie had a great many shared interests, including hiking, opera, and vacationing in the national parks, particularly Yosemite National Park, where many of the rangers and staff knew them on a first-name basis.

Dr. Hartman is survived by his wife, Bonnie Sherrill Hartman, of Carmichael, California; by his daughter Sherilyn Hartman-Knoll, of Carmichael, California; and son Greg and wife Cheryle, of Flagstaff, Arizona. In addition, he is survived by six grandchildren and two great grandchildren.

It is our pleasure to have known Howard in all of his many roles—professor, mentor, author, leader, administrator, and most of all, friend.

Martin C. Hemsworth

MARTIN C. HEMSWORTH

1918–2009

Elected in 1980

"For contributions to all phases of aircraft gas turbine design and development including responsibility for first high bypass turbofan used worldwide."

BY DONALD W. BAHR

MARTIN C. HEMSWORTH, a pioneer in the design and development of aircraft jet engines, died on March 28, 2009.

As an engineering leader at General Electric Aircraft Engines (GEAE), Martin was a significant contributor to the advancement of aircraft turbine engine technology for more than 60 years. Among his major accomplishments was his team leadership role, during the late 1960s, in the design, development, and qualification of the TF39 turbofan engine for the U.S. Air Force C5 Galaxy transport aircraft. This engine was the world's first high-bypass turbofan—a revolutionary design concept that rapidly transformed military and commercial aviation. With this concept, large thrust increases together with large fuel efficiency improvements were realized. This engine type is now extensively used in many military and commercial aircraft applications.

At GEAE, versions of the TF39 engine, the CF6 engine family, were soon evolved for commercial aircraft, including the Boeing 747. These efforts led, in turn, to the development of several other turbofan engine models for a large variety of aircraft applications and established GEAE as a major supplier of turbofan engines for both commercial and military aircraft.

Martin was elected to the National Academy of Engineering in 1980. He served on the Section 10 Membership Committee and on several study committees.

Martin was born on June 3, 1918, in Waterloo, Iowa. His parents were Carl A. and Gladys (nee Martin) Hemsworth. He attended the University of Nebraska, Lincoln, College of Engineering and Technology. He graduated in 1940 and immediately started his long career with GEAE.

His early assignments involved aircraft engine supercharger and jet engine test facility design efforts at the General Electric plant in Lynn, Massachusetts. In 1948 he was a part of an eight-person team sent to Cincinnati, Ohio, to set up a plant to manufacture J47 engines for the U.S. Air Force. During the next several years, in both Cincinnati and Lynn, Martin led a variety of military aircraft engine design teams. In 1964 he was designated the design team leader of the aforementioned TF39 engine project. In 1970 he was appointed to the newly established position of GEAE chief engineer. He held that post for most of the next 17 years. In this capacity he reviewed and monitored the entire array of GEAE's engineering activities, which encompassed turbofan, turbojet, and turboshaft engines for a broad spectrum of commercial and military aircraft as well as marine and industrial applications. As such, he was a key contributor to the evolution of all GEAE products during the 1970s and 1980s. He retired in 1987 but continued to participate in GEAE's activities as a senior consultant for the next 13 years.

In addition to his duties at GEAE, Martin was frequently called on to serve as a consultant to other General Electric business units. In particular, he often served as a consultant to General Electric's land-based gas turbine unit.

In addition to election to the National Academy of Engineering in 1980, Martin received several other honors. He received two prestigious General Electric awards for engineering excellence—the Ralph J. Cordiner Award in 1963 and the Charles Steinmetz Award in 1977. He was elected to the General Electric Propulsion Hall of Fame in 1987. He received the Society of Automotive Engineers (SAE) Frank W.

Kolk Award in 1964. In 2000 he received the American Society of Mechanical Engineers (ASME) R. Tom Sawyer Award. This award recognizes important and lasting contributions to the gas turbine industry. Martin had 18 patents and authored several journal papers. He was a fellow of ASME and SAE.

In 1994 Martin and his wife, Ann, established an endowed scholarship and fellowship for engineering students at the University of Nebraska, Lincoln. The university named an engineering lecture hall in their honor. In 2000 the university awarded Martin its Outstanding Alumnus Award for demonstrating ethics, community responsibility, and overall professional excellence.

Martin is survived by a son, John, and a brother, James. His wife, Ann, died in 1999. They were married for 53 years.

Martin was an exceptionally skilled engineer and an outstanding engineering leader. During a career that spanned six decades, he witnessed and directly participated in the explosive growth of aircraft jet propulsion from its earliest days. He was an important contributor to this spectacular progress. As a result, he was renowned and respected throughout the industry for his expertise and many innovations.

At GEAE he was similarly highly esteemed for his engineering excellence and for his very appreciable impact on the success and growth of the GEAE business. He was also highly esteemed for his always great enthusiasm, geniality, and abiding gentlemanliness. He was universally known as Marty by all of his associates. To generations of GEAE engineers, he was a role model and a valued adviser and mentor. To all of the many GEAE persons who enjoyed the opportunity of working with him, Marty is always fondly remembered as "The Chief Engineer."

KENNETH J. IVES

1926–2009

Elected in 2003

"For contributions to the theory and practice of water-treatment technology throughout the world."

BY JOHN GREGORY
SUBMITTED BY THE NAE HOME SECRETARY

KEN IVES, who died suddenly at age 82, on September 8, 2009, was an internationally recognized authority in the field of drinking water treatment. His research has had an enormous influence on the principles and practice of water filtration and gave him an unrivaled reputation in the subject. Ken was elected as a foreign associate of the National Academy of Engineering (NAE) in 2003.

Ken was born in 1926 in Kentish Town, London, and was educated at William Ellis School. During World War II, he was evacuated to Leighton Buzzard, a town about 40 miles northwest of London, which was relatively safe from bombing raids. Coincidentally, Leighton Buzzard is well known for its sand quarries, which are an important source of sand for filters in water treatment plants. In 1945 Ken entered University College London (UCL) to study civil engineering. He maintained an association with UCL for the rest of his life. After graduating with a B.Sc. in engineering in 1948, he spent seven years as an engineer with the Metropolitan Water Board (MWB) in London. At MWB he carried out research on the removal of algae from reservoir water, and this work formed the basis of his Ph.D. degree, which was supervised at UCL. Several publications on his algal research appeared, and these have had a high impact on later studies in this area. These early papers are still being quoted by scientists around the world.

After his time at the water board, Ken returned to UCL as a lecturer in the civil and municipal engineering department in 1955. Promotion to reader followed in 1963 and to professor of public health engineering in 1967. He became Chadwick Professor and Head of Department in 1984, a position he held until his retirement in 1992. He was a superb teacher at all levels, and his lectures to undergraduates were very popular. Ken played a major role in the general life of UCL, serving on many important college committees and as dean of students for two years. He fully committed himself to these tasks and gave them a lot of time and attention. He was elected a fellow of UCL in 1996 and continued to be active in the social life of the college, notably as a frequent contributor to the discussions of the Natural Sciences Club. His last visit to UCL was on the day before he died.

Ken Ives began his fundamental research in water filtration in the 1950s, and he pursued this topic during a sabbatical year at the Harvard School of Public Health, with Gordon Fair, in 1958–1959. His year at Harvard was made possible by the award of a Fulbright fellowship. Ken was a pioneer in the use of computers to model the behavior of sand filters, which were (and still are) a very important part of conventional drinking water treatment. As a result of this work, Ken showed that traditional deep-sand filters were inherently inefficient, with most of the impurities being removed in just the top layers, so that a filter would become clogged when much of its potential removal capacity remained unused. This led to the development of new designs, such as upflow or stratified filters, which gave much better performance.

At UCL Ken also carried out detailed experimental filtration studies, using specially designed columns that enabled water samples to be taken at many points throughout the depth of the filter and pressure profiles to be recorded. With this approach, he carried out investigations on the mechanisms of particle capture by grains in a filter bed, both theoretically and experimentally. Later, he used advanced fiber optic techniques and high-speed video recording to directly observe particle movements within the pores of a filter bed.

As well as these fundamental studies, Ken worked on more practical aspects of water filtration. His experimental columns were adapted for use in pilot-scale investigations in water treatment plants, and he designed simple test equipment for lab-scale filter testing. He was also interested in low-cost water filtration methods, applicable to developing countries. One example was a "pebble-matrix filter" for the treatment of highly turbid waters, common in monsoon regions. This acts as a very effective pretreatment unit that greatly reduces the load on subsequent treatment stages. The process is now being used successfully in Sri Lanka.

Although Ken is best known for his filtration research, he worked on several other aspects of water quality and treatment. His work on coagulation and sedimentation processes is a significant example, and he produced a useful model for the behavior of a common type of water treatment clarifier. He also carried out more general studies, such as a feasibility study of dual water supplies and optimization of treatment plant operations.

Much of Ken's research at UCL was carried out with the help of several generations of research students, many of whom went on to make very successful careers in industry or academia. His reputation enabled him to attract very able research colleagues and a succession of distinguished international academic visitors to his lab. His students and colleagues will remember him with gratitude, admiration, and affection.

In 1964 Ken was a (U.S.) National Science Foundation senior visiting fellow at the University of North Carolina. Later, he had a long association with the Delft University of Technology, Netherlands, as a visiting professor.

Ken was invited to many major national and international conferences, often as keynote or plenary lecturer. He formed lifelong friendships with many overseas colleagues and became very well known in the worldwide water treatment community. He organized a series of NATO Advanced Study Institutes in Cambridge between 1973 and 1982, which became highly influential. The first of these resulted in a book, *The Scientific Basis of Filtration* (Noordhof, Leyden, 1975), that became known to some of his colleagues as the "Gospel According to St. Ives." For many delegates these meetings proved to be hugely important to their careers and an informal "old boy" network still exists of people who will be eternally grateful to Ken for bringing them together in this way.

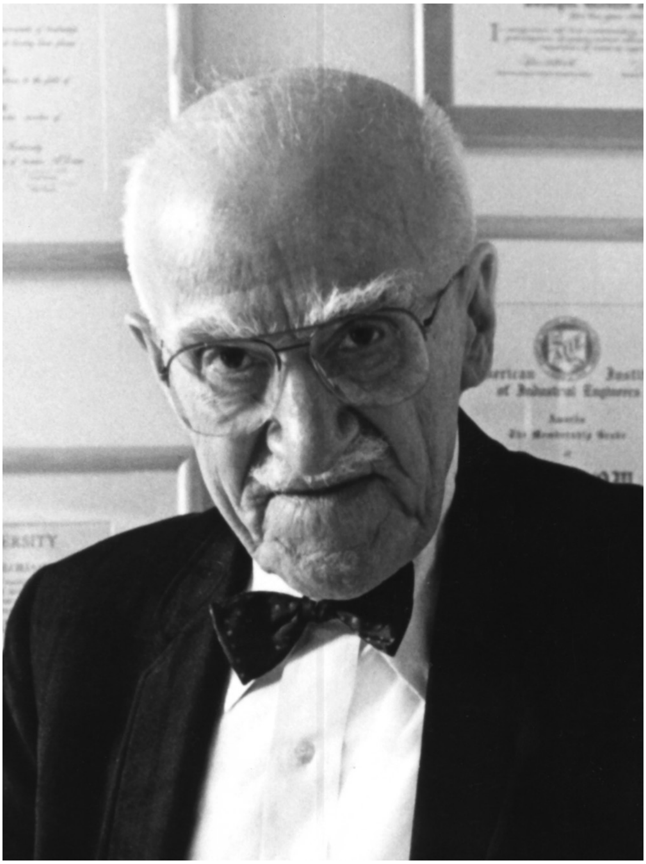
From quite early in his career, Ken was increasingly involved in national and international aspects of water supply and treatment. He was a consultant and expert adviser to the World Health Organization (1966–1992) and made many visits to developing countries to advise on water supply and treatment. He was active in the International Water Association (IWA) and was editor-in-chief of its journal Water Research from 1983 to 1995. He also served as regional editor for the United Kingdom, a role in which he continued until 2001. Ken served on the Badenoch Committee on Cryptosporidium in Water Supplies (1989–1995). In 1994 he headed an official inquiry into the Severn River pollution incident and its impact on public water supplies.

Ken received numerous medals and awards, including the Gold Medal of the Filtration Society (of which he was a founder member and past chairman) in 1983, the S. H. Jenkins award from the International Association on Water Pollution Research and Control (now IWA) in 1990 and the Simon W. Freese Award and Lecture from the American Society of Civil Engineers (ASCE) in 1994. He was a fellow of the Royal Academy of Engineering and of the Institution of Civil Engineers and held life memberships in ASCE, the American Water Works Association, and the Water Environment Federation. In 1996 he was honored by Her Majesty Queen Elizabeth II with the award of Commander of the Order of the British Empire for services to the environment. His election as foreign associate of NAE in 2003 was for his contributions to the theory and practice of water treatment technology throughout the world.

Outside of his academic and professional life, Ken was involved in the Boy Scout movement and served as a magistrate for some time. In his last few years Ken again lived in Leighton

Buzzard and played an active part in the social life of the town, including as a member of the local U3A (University of the Third Age) group. During this time he gave regular talks to school children at the Imperial War Museum, in London, recounting his experiences as a wartime evacuee. He loved traditional jazz and was a devotee of ballroom dancing. He was very sociable, and his many friends will miss him greatly.

Ken is survived by his wife Brenda, whom he married in 1952, and his daughter Cherrill Theobald and son Matthew.



JOSEPH M. JURAN

1904–2008

Elected in 1988

"For pioneering contributions in developing the practice of statistical quality control, and in developing engineering design principles based on statistical concepts."

BY KENNETH E. CASE

JOSEPH M. JURAN, founder of the Juran Institute for Leadership in Quality and a pioneer, teacher, consultant, and guru of quality control, died on February 28, 2008, at the age of 103. He was elected a member of NAE in 1988 for "pioneering contributions in developing the practice of statistical quality control, and in developing engineering design principles base on statistical concepts."

Joseph Moses Juran was born on December 24, 1904, in Romania. Eight years later, the family immigrated to Minneapolis to escape poverty and the threat of violence against Jews. Joseph became a naturalized U.S. citizen in 1917 and served as a second lieutenant, eventually captain, in the U.S. Army Signal Corps Reserve performing cryptanalysis.

He went on to become the world-renowned elder statesman of quality control. His 75-year career included 17 years at Western Electric, four years on loan to the Lend Lease Administration beginning soon after the attack on Pearl Harbor, and more than 50 years as a management consultant. Joseph was not only a pioneer in the field of quality control field, but was also one of the most revered leaders in the field.

Joseph Juran was elected to the National Academy of Engineering in 1988. In 1992, he was awarded the National Medal of Technology by President George H. W. Bush "for his lifetime work of providing the key principles and methods by which enterprises manage the quality of their products and processes." Even earlier, in 1981, he was awarded the Order of the Sacred Treasure by the emperor of Japan. That same year, he received the Frank and Lillian Gilbreth Industrial Engineering Award, the highest honor given by the Institute of Industrial Engineers. He also received the Grant Medal (1967), Edwards Medal (1962), and Brumbaugh Award (1958) from the American Society for Quality Control, any one of which is considered the capstone of a career; Joseph went on to contribute for another 40 years.

By the time he was 20, Juran had held 16 jobs, including his first job selling the *Minneapolis Tribune* at a streetcar stop. When he wasn't working, he continued to pursue his formal education. His teachers kept moving him ahead to challenge him, and in 1920 he entered the University of Minnesota, where he received his B.S. in electrical engineering in 1924. College was a challenge, and maintaining a C average was sometimes a struggle, as he continued to work to make ends meet. In 1926, he joined the inspection statistical department at Western Electric, one of the first such departments ever established.

In 1929, at the age of 24, Joseph was appointed chief of Western Electric's Quality Inspection Results Division, which oversaw five departments. In 1935, still working at Western Electric, Joseph earned a J.D. from Loyola University. Practicing law was his backup employment plan during the depression. In 1937, he moved to New York to become corporate industrial engineer at Western Electric/AT&T headquarters. About this time he also became active in the Society for the Advancement of Management, American Management Association, and American Society of Mechanical Engineers.

In 1941, while on a benchmarking visit to General Motors, he discovered the work of Vilfredo Pareto on the distribution of wealth (that relatively few people own the great majority of the wealth). He applied this principle to quality by showing conclusively that relatively few contributors (e.g., components) in a system—the vital few—account for the bulk of the effect (e.g., defects). He later discovered that this principle had been incorrectly attributed to Pareto, but more than 50 years later, when he was asked if the name should be changed to the "Juran principle," he said, "No, but perhaps after I go to the great beyond."

The same year, 1941, he was "loaned" by Western Electric to the Lend Lease Administration for six weeks, starting on Christmas Day. As World War II continued, the six weeks stretched into four years.

From 1945 to 1949, Joseph began his career as a consultant, assisting clients such as Gillette, BorgWarner, and Hamilton Watch Company. During this time he became a founding member of the American Society for Quality Control (ASQC). From 1949 to 1979, he had his own consultancy. Beginning with clients such as General Foods, Bausch and Lomb Optical, and International Latex., his client list quickly grew to include many North American and international organizations. From 1950 to 1991, he made 178 trips abroad to lecture, consult, teach courses, and attend quality conferences in 34 countries.

In 1979, Joseph incorporated the Juran Institute for the purpose of transferring his knowledge to a set of 16 videotapes, the "Juran on Quality Improvement" package, which included 50 workbooks, two leader's manuals, and three books. The Juran Institute eventually expanded to offer consulting services, workshops, papers, and additional books and tapes. In 1987, Joseph stepped down from his position as chairman and CEO of the institute to become chairman emeritus. From 1988 to 1991, Joseph was tapped to serve as a founding member of the U.S. Malcolm Baldrige National Quality Award Board of Overseers.

Joseph's writings number in the hundreds, many of them translated into 30 different languages. His books span nearly 60 years, beginning with *Bureaucracy: A Challenge to Better Management* in 1944 (probably still relevant today) and ending with his memoirs, *Architect of Quality,* published in 2003.

Juran's Quality Control Handbook, which has been published in many editions since it first appeared in 1951, is still considered the definitive compilation on quality. *Quality Planning and Analysis,* published in several editions since 1970, is used throughout the world by both practitioners and academics.

According to Joseph's son Donald, his father always told him, "Never be without a project." Speaking a few days after his father's death, Donald added, "And he never was." Joseph's contributions were motivated by his strong underlying beliefs developed over many years of helping people. A few of his sayings, captured by Hélio Gomes in *Quality Quotes* (ASQ Quality Press, 1996) are listed here:

- On the cost of poor quality: "In the U.S.A., about a third of what we do consists of redoing work previously done."
- On the definition of quality: "Quality is fitness for use."
- On quality control: "For quality in the sense of freedom from deficiencies, the long-range goal is perfection."
- On innovation: "Improvement means the organized creation of beneficial change; the attainment of unprecedented levels of performance. A synonym is 'breakthrough.'"
- More on innovation: "To achieve improvement at a revolutionary pace requires that improvement be made mandatory—that it become a part of a regular job, written into the job description."
- On standards/standardization: "Without a standard, there is no logical basis for making a decision or taking action."
- On top management commitment: "Observing many companies in action, I am unable to point to a single instance in which stunning results were gotten without the active and personal leadership of the upper managers."
- On total quality management (TQM) implementation: "The recipe for action should consist of 90% substance and 10% exhortation."

- On TQM leaders and managers: "All managerial activity is directed at either breakthrough or control. Managers are busy doing both of these things, and nothing else."
- More on TQM leaders and managers: "Had Deming (also an NAE member and National Medal of Technology recipient) and I never gone there, the Japanese quality revolution would have taken place without us . . . the unsung heroes of the Japanese quality revolution were the Japanese managers."

Joseph's vision for this country was that the 21st century would be the "Century of Quality." In 1994, he had argued for a national center for the study of quality. In 1997, he realized this ambition when the Carlson School of Management at the University of Minnesota established the Joseph M. Juran Center for Leadership in Quality. The center focuses on rigorous research, educating scholars, and the discovery, dissemination, and teaching of quality leadership in the United States and around the world.

In 2000, the American Society for Quality (ASQ) introduced the Juran Medal in Joseph's honor. The medal is awarded to individuals who "exhibit distinguished performance in a sustained role as an organizational leader, personally practicing the key principles of quality and demonstrating breakthrough management." In 2000 the recipient was Robert W. Galvin, and in 2003 the recipient was John A. Young, both NAE members.

Following Joseph's death, *Quality Progress,* the flagship publication of ASQ, invited readers to share their thoughts, some of which are listed below

- "At a time when the field of quality was often contentious and our new Baldrige effort was still fragile, Dr. Juran was a steadying influence, bringing credibility and confidence to our work. His services and leadership within the first Board of Overseers were a key foundation for our early work, enhancing the award's stature in the U.S. and around the world."
  —Curt Reimann, first director of the Baldrige National Quality Program.

- "The last time I saw him was in the White House when the first Baldrige Awards were given, and his first words to me were, 'You should be proud of what you accomplished to bring this award about.' Typical graciousness by a great man. The world and I will miss him."—Jack Grayson, founder, American Productivity and Quality Center.
- "I visited Juran late last year, arriving unexpectedly during lunchtime. 'If you had told me you were coming, we could have had lunch together. Now, you'll have to watch me eat mine.' He was obviously working hard, his desk covered with papers. It was the first time I had seen him in several years, and although he was slower afoot there was nothing, literally nothing, lacking in his mental agility. I departed amazed at the man's vitality. Rare events, wonderful rare events, do occur."—J. Stuart Hunter, NAE member, Professor Emeritus, Princeton University.
- "Dr. Juran wrote that the purpose of the (Juran) Institute is to improve the quality of society. He said, 'Whatever you do, make sure it improves society. Don't just do it for the sake of profit.'"—Joseph A. DeFeo, president and CEO, the Juran Institute
- "Dr. Juran changed many lives. He did so through his books, videos, recordings, papers, and public addresses. He did so by simply striking up a conversation with a stranger at a conference. He changed lives by setting an extraordinary example. Through his deeds. His generosity. His wisdom. His unselfish focus on humanity. And his unrelenting goal to pay back a debt to society for the opportunities presented to him over the years. Everything he said or did represented the kind of human qualities we would all like to emulate."—Howland Blackiston, Juran's grandson-in-law and producer of the documentary, "An Immigrant's Gift."
- "Heaven will get better."—Joaquim Donizetti Donda, an ASQ member.

Married for 81 years, Joseph is survived by his wife Sadie, four children, and many grandchildren and great-grandchildren.

Note: The author appreciates the generosity of ASQ, especially Mark Edmund, for permission to use material from "The Architect of Quality: Joseph M. Juran 1904–2008," *Quality Progress,* April 2008.

His son, Charles wrote:

I want to tell you about my Dad but it isn't easy to find the words while emotions are still ragged and raw. How do you look at a life and explain what it meant? Most brave things are done in private and there is no medal for being faithful or meeting one's responsibilities. Eulogies at least give us a chance to honor these things.

His amazing journey began when Theodore Roosevelt was in the White House and Hitler, a failed art student. He persevered through grinding poverty in the early days, endless wars, a frightening depression, family problems, and a complete lack of social skills resulting from the upbringing he had.

Later in life things mellowed for him and the accolades came, although he never sought them. His touchstone, from Kipling, was to meet triumph and disaster on equal terms. He doted on his grandchildren and great-grandchildren. In this, we were able to give something back. I treasure what he inscribed to us in one of his books: "To the Redlands Jurans: you have so sweetened these years."

I inherited his flair for technical things and we had a wonderful relationship but his greatest gift to me was not the genes (although that was major), it was a moral compass I struggled vainly to emulate: knowledge, humility, a stern work ethic, honor, absolute honesty, justice, and love of his family and country.

The Last of their Kind

They are all gone now, the last survivors of that little band of immigrant kids who sailed to America in 1912. These three, unlike today's immigrants, were tossed cold turkey into an English-speaking school, to sink or swim. They chose to swim.

Out of that little shack in Minneapolis came three who had a huge influence on my life: Aunt Min, who had to go to an orphanage when her mother died, overcame her upbringing, put her ambitions on hold until her family was raised, and finally went to college, all the way to Ph.D. status. And Uncle Nat, who never bore a grudge about his poverty years, studied architecture at MIT, switched to the movie business, and became an Oscar winning director.

And my Dad, overcoming the demons from a bitter childhood to achieve worldwide prominence in his chosen field of managing for quality. Only in America! And although this is still the land of opportunity, I don't think we'll see their like again.

ROGER P. KAMBOUR

1932–2008

Elected in 1992

"For pioneering investigations of the structure of crazes in glassy polymers and discovery of their importance in polymer fracture."

BY WILLIAM J. WARD

ROGER KAMBOUR was a chemist at the General Electric Research and Development Center and a research professor at the University of Massachusetts. His pioneering work on crazing and fracture of glasslike thermoplastics laid the foundations for our current understanding of fracture resistance in rigid polymers.

He was born April 1, 1932, in Winchester, Massachusetts, and was raised in nearby Wilmington, 17 miles north northwest of Boston. His father was a math teacher, his mother a music teacher. He was educated at Wilmington High School (where his father was principal), Amherst College (B.A., *cum laude*, 1954), and the University of New Hampshire (Ph.D., 1960).

In August 1960, immediately after receiving his Ph.D., he joined General Electric's Corporate R&D Center at Schenectady, New York, where he worked until his retirement some 34 years later. Throughout a long career, he remained dedicated to research and continued to publish articles in learned polymer journals, the last of them appearing in *Macromolecules* in 2000. From 1962 to 1980, his publications were almost exclusively about crazing and fracture. Thereafter, his output became more diverse; while still including occasional papers on crazing, it also covered flammability, polymer-polymer miscibility, stress relaxation, mobility of diluents, and polymerization of cyclic oligomers. These studies reflected both his original training as a physical chemist and his commitment to industrially relevant research. Another factor was his close collaboration with leading figures in the academic world. He spent a month at Imperial College in 1981, in a collaboration that involved the application of neutron scattering to fundamental questions concerning the miscibility of polystyrene with poly (1,4-dimethyl-2,6-phenylene ether), a topic of direct relevance to General Electric's plastics business.

Roger spent a four-month sabbatical at the Massachusetts Institute of Technology in 1991 as a visiting professor and eight months at the National Institute of Standards and Technology in 1993 as a visiting scientist. In 1994 he officially retired from General Electric, but he retained an office there and served as a research professor at the University of Massachusetts.

Roger's work on crazing had a profound effect on polymer physics. For a long time, crazes were regarded simply as small noncritical cracks. To the naked eye that is exactly what they looked like, and the words "cracking" and "crazing" were used interchangeably, especially in the terms "solvent stress-cracking" and "solvent-crazing," which refer to craze formation in the presence of organic liquids. This phenomenon was a problem for General Electric, as a producer of both electrical appliances and Lexan polycarbonate, hence the decision to recruit a staff member to investigate it. In a 1999 publication, Roger recalled his despondency at being asked to work on a topic that appeared to be more of a trouble-shooting exercise than serious scientific research. However, his doubts were dispelled within 12 months, first by news that Spurr and Niegisch had observed solid matter inside crazes, which meant that they were not true cracks, and then by his own definitive experiments, which demonstrated that crazes are porous, load-bearing structures. By measuring the critical angle for total internal reflection from alcohol-induced crazes formed in polycarbonate under tensile stress, Roger was able to show that they consisted of 50 percent polymer and 50 percent ethanol, by volume. Furthermore, when the alcohol evaporated (quite quickly) with the specimen at constant strain, it was replaced with 50 percent air. These tests showed that the voids were all interconnected and that craze material is homogeneous under visible light. He later showed that tensile stresses are sustained by threads only a few molecules in thickness and that crazes invariably form ahead of a crack tip in glassy polymers.

Establishing a connection between fracture behavior and crazing (which could now be recognized as an energy-absorbing deformation micromechanism) represented a major advance in our understanding of mechanical properties. On reading Roger's 1964 article on the subject, researchers in England looked for evidence of crazing in rubber-toughened polystyrene and showed that large numbers of crazes form around a loaded crack tip in this commercially important class of polymer blends, thereby explaining how adding 8 percent rubber could transform brittle PS into the "high-impact" grade known as HIPS and opening up the whole subject of toughening mechanisms in polymer blends. The formation of craze fibrils also helped explain why chain length (and therefore molecular weight) is so important in thermoplastics. Other developments included measurements of natural draw ratios for craze fibrils and their correlation with contour lengths between entanglements, studies on craze healing at elevated temperatures, and Roger's own studies on solubility parameters as a guide to critical strains for solvent crazing. Turning from materials science to pure engineering, crack-tip crazes were soon recognized by the fracture mechanics community as ideal examples of Dugdale plastic "line zones." Crazing is now a standard topic in textbooks on polymer science, perhaps the highest form of recognition for any scientist.

Roger received a number of awards for his work. He was awarded a Coolidge fellowship, the highest award of the General Electric Research and Development Center, in 1979. He was a fellow of the American Physical Society (APS), and he won the Union Carbide Award from the American Chemical Society and the Ford Prize for Polymer Physics (jointly with E. J. Kramer) from APS. He was elected to the National Academy of Engineering in 1992.

Perhaps the most notable mark of recognition that Roger received was an invitation from APS to contribute a short autobiographical note to one of its publications. The occasion was the centenary of APS in 1999, which the Polymer Physics Division decided to mark by collecting contributions from a select group of eminent scientists whose research had shaped polymer physics over the previous half century. The resulting article, which appeared in the *Journal of Polymer Science (Part B)* in 1999, contains two-page historical notes from 14 internationally renowned physicists, each a leader in his field. Roger's name rightfully appears in this unique roll of honor.

In his leisure time, Roger was a skilled cook, an enthusiastic member of several choral societies (including Amici Cantorum), and a passionate supporter of Amherst College. He was a skillful downhill skier who took his turn in the Hickory Hill Ski Patrol in New York State during the 1980s. During the summer he enjoyed sailing and canoeing. He was also active in a variety of civic activities. In all his activities, Roger displayed a well-developed sense of humor, combining serious intent with a sociable personality and a wide range of intellectual interests.

Above all, Roger's primary passion was his family. Whether attending various concerts, sporting events, or family reunions, he cheered his children and family in their achievements.

Roger died on December 20, 2008. He is survived by his wife, Barbara Vivier; his daughter, Annaliese; and sons Christian and Joshua.

RAPHAEL KATZEN

1915–2009

Elected in 1996

"For the advancement of biotechnology for chemicals from renewable resources worldwide."

BY DONALD JOHNSON

RAPHAEL "RAY" KATZEN, leading visionary on fuels and chemicals from renewable resources and founder of the foremost cellulosic ethanol consulting firm, Katzen International, passed away in July 2009, 16 days short of his 94th birthday.

Dr. Katzen was born in Baltimore, Maryland, on July 28, 1915, to Isidor and Esther (nee Stein) Katzen, and was raised in New York, New York. He had one brother, Saul, who preceded him in death. Ray achieved his bachelor's, master's, and doctoral degrees, all in chemical engineering, from the Polytechnic Institute of Brooklyn (now the Polytechnic Institute of New York University). After teaching chemical engineering at the institute for a short while, Dr. Katzen began a long industrial career, starting as director of research for Northwood Chemical Company. Later, he joined the Diamond Alkali Company as technical supervisor in research and development and then moved on to manager of the Engineering Division of Vulcan Copper and Supply Company, which became Vulcan Cincinnati during his tenure.

While at Vulcan, Ray's engineering group designed and oversaw the construction and operation of an ethanol-from-wood plant in Springfield, Oregon, part of the federal government's program to produce ethyl alcohol for synthetic rubber during World War II when natural rubber supplies from the Far East were cut off. This and the other fermentation alcohol plants were either sold off or shut down after the war, victims of the superior economics of petrochemical-derived ethanol. The experience broadened Ray's expertise in biochemical processing, expertise that he had been gaining along his career path. Through Vulcan he gained international experience, especially in Cuba. Ray designed the Bacardi family's first modern distillation system in Santiago, Cuba, which led to an enduring friendship and business relationship with the Bacardi family.

Dr. Katzen resigned from Vulcan and formed his own consulting company in 1953. He took on partners and, as the group acquired international business, it evolved into Raphael Katzen Associates International, Inc., in 1955. In 1997 Ray and his wife of 71 years, Selma, sold their interest in the company, RKAII, that was doing business on every continent and currently has 135 processes in 40 countries around the globe. Ray did not retire, though, for he was only in his early 80s. He and Selma set up a small independent consulting company in Bonita Springs, Florida, where they also resided and, until his death, traveled to meet with clients around the globe.

Ray was a registered professional engineer in 16 states. He was a member of the American Institute of Chemical Engineers (AIChE), the American Chemical Society (ACS), the Technical Association of the Pulp and Paper Industries, the American Institute of Chemists, the Pulp and Paper Technical Association of Canada, the advisory board of the annual Chemical Process Industries Exposition (Chem Show), and the Board of Fellows of the Polytechnic Institute of Brooklyn.

Ray was truly a pioneer in the renewable fuels effort and the cellulosic ethanol area in particular. As stated by Phil Madson, president of Katzen International: "Where the world is today with ethanol was very clear in his [Ray's] mind in the 1940s.

I think he has challenged more people in this field, scientists, engineers, owners, bankers, lawyers, and government officials, than any other one person has ever challenged the industry."

Dr. Katzen was elected to the National Academy of Engineering in 1996 "for the advancement of biotechnology for chemicals from renewable resources worldwide." He was a fellow of the AIChE, a trustee of the AIChE Foundation, and a member of AIChE's Legacy Society. In 1986 he was honored by AIChE with the Award in Chemical Engineering Practice and in 2001 received the institute's Founders Award for Outstanding Contributions to the field of chemical engineering. In 2008 he was recognized by the U.S. Department of Energy as the first recipient of its Raphael Katzen Award in recognition of his distinguished contributions to the deployment and commercialization of fuels and chemicals production from renewable feedstocks.

Ray also received a Lifetime Achievement Award in 1999 from the Renewable Fuels Association, a Special Lifetime Achievement Award in 2000 from the ACS, and the first Award of Excellence for Outstanding Technical Achievements at the Sixteenth Annual Fuel Ethanol Workshop.

Notwithstanding all the awards and achievements Dr. Katzen received, he will likely be remembered most by those who attended seminars, conferences, and technical meetings with him for the penetrating and insightful questions he always asked after a presentation, ensuring that the wheel would not be reinvented, that the economics made sense, and that the science or technology being presented was soundly grounded with credible data. He will be sorely missed in the bioprocess industries, but his legacy will live on in a flourishing renewable fuels and chemicals industry stimulated by his decades of inspiration and leadership.

His daughter wrote that:

> In addition to his wife, Selma, Ray is survived by his daughter Nancy and her husband, Dick; grandchildren, Andy, Chris (Amy), Kim (Frank); and seven great grandchildren, Savannah, Casey, Jasmin, Bryce, Jackson, Sophia, and Dylan. Ray loved to travel and he

and Selma took their daughter on many trips to Cuba, South America, and Europe and later they took their grandchildren on various trips from Hawaii to Europe and South Africa, instilling in all of them a love of travel and adventure. He passed on to them a desire to excel with the determination and belief that they could realize their dreams. Their memories include his brilliant mind, his ready laugh, his positive attitude and his famous red Stuart tartan Christmas suit (jacket, pants, vest, tie) that he wore each year for more than 40 years.

Ray also loved his BMWs, participating in many races at the track in Midway, Ohio, and took many family members and friends on white-knuckle new car demonstration rides. Ray was always an optimistic person who looked forward to the future. His only regret may have been that he always wished that he would outlive Fidel Castro so that he could return to Cuba where much of early business began. He loved his family, friends, and peers deeply and they loved him back. He will be missed by his family and friends throughout the world. He was truly a unique person.

Ken Kennedy

KEN KENNEDY

1945–2007

Elected in 1990

"For pioneering contributions to the field of optimizing compiler construction and parallel processing."

BY MOSHE Y. VARDI

KENNETH ("KEN") W. KENNEDY, John and Ann Doerr University Professor of Computational Engineering, Department of Computer Science, Rice University, died on February 7, 2007, in Houston at the age of 61. His research on software paved the way for the widespread use of computers in science and engineering.

Ken graduated *summa cum laude* from Rice University in 1967 and returned four years later, after earning one of the first doctorates in computer science awarded by New York University (NYU). Internationally known for his expertise in programming-language implementation and high-performance computing, two new disciplines he was introduced to during his graduate studies at the NYU Courant Institute of Mathematics in the late 1960s and early 1970s, Ken always credited his Ph.D. adviser, Jack Schwartz, with opening his eyes to the possibilities of high-performance computing.

Ken was elected a member of the National Academy of Engineering in 1990. He founded the Department of Computer Science at Rice in 1984, the interdisciplinary Computer and Information Technology Institute (CITI) in 1987, the Center for Research on Parallel Computation (CRPC) in 1989, and the Center for High Performance Software Research (HiPerSoft) in 2000.

Ken Kennedy had a well-earned reputation for leadership. In 1997, he was chosen co-chair of the President's Information Technology Advisory Committee (PITAC). The panel's 1999 report, which recommended that U.S. leaders increase spending for computing research by more than $1 billion, was a catalyst for increasing support from numerous federal agencies for research on information technologies (IT). For this accomplishment, the Computing Research Association awarded Ken and a colleague, Bill Joy, its Distinguished Service Award.

In 1988, Ken led a group of computer scientists from seven leading research institutions in putting together a proposal for the establishment of a National Science Foundation (NSF)-funded Center for Research on Parallel Computation (CRPC), one of the first NSF science and technology centers. CRPC later evolved into HiPerSoft, which Ken directed from its inception. HiPerSoft was the administrative home at Rice of several multi-institutional projects, including the Virtual Grid Application Development Software Project, an NSF-sponsored collaboration involving seven universities, and the Los Alamos Computer Science Institute, a consortium of five universities and the Los Alamos National Laboratory.

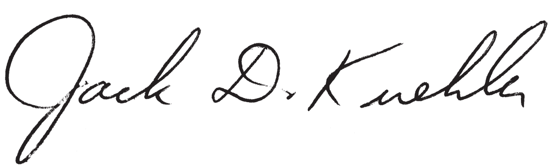
Remembered at Rice for his love of students and of teaching, Ken was a Ph.D. adviser to 38 students and a mentor to many more. He continued to teach undergraduate courses long after he became prominent in his field. In 2002, he was promoted to the highest academic rank at Rice, University Professor. At the time of his death, he held joint appointments in computer science and in electrical and computer engineering.

In 2003, the Association of Computing Machinery Special Interest Group on Programming Languages (ACM SIGPLAN) published a volume containing the 50 most influential papers published in the ACM *Conference on Programming Language Design and Implementation* between 1979 and 1999. Few researchers had more than one paper in that collection. Ken had five, and three of his former students had two or more.

For more than two decades, Ken's research was focused on the development of high-level programming tools for parallel and distributed computer systems. As a result of his efforts, supercomputers became much more accessible to scientists and engineers. His contributions to the field were recognized by his peers when he was awarded the 1999 Lifetime Achievement Award from ACM SIGPLAN.

Ken authored more than 200 technical articles and wrote two books. He was a fellow of the ACM, the American Association for the Advancement of Science, the Institute of Electrical and Electronics Engineers (IEEE), and the American Academy of Arts and Sciences. In recognition of his achievements, he received the 1995 W. W. McDowell Award, the highest research award given by the IEEE Computer Society.

Mr. Kennedy is survived by his wife, Carol Quillen; his stepdaughter, Caitlin Lohrenz; his father, Brig. Gen. Kenneth Kennedy, Sr.; and a sister, Susan Kennedy.



JACK D. KUEHLER

1932–2008

Elected in 1984

"For outstanding engineering, technical, and management leadership in applying leading-edge computer technology to innovative data processing products."

BY NICHOLAS M. DONOFRIO

JACK KUEHLER, an electrical engineer and former president and vice chairman of the IBM Corporation, died on December 20, 2008, in Rancho Santa Fe, California. He was 76.

Hired in 1958 as an associate engineer at IBM's San Jose Research Laboratory, Jack went on to become the highest-ranking technologist at IBM and a mentor to a generation of IBM managers and technical professionals. He guided IBM's highly successful launch into the open-standard workstation computing marketplace and was the architect of a series of alliances that not only restored IBM's position as a global technology leader but also shored up America's technological competitiveness.

Jack was revered by the global IBM technical community, not only for his leadership, intellect, and warm manner but also for his example. He was the first engineer to become IBM president, a standout in a company whose senior executives normally rose through the sales or marketing ranks. He also was IBM's most senior proponent of "wild ducks," an IBM term for engineers and other technical employees who refused to accept the status quo.

Jack was born in Grand Island, Nebraska, in 1932. He studied mechanical engineering at Santa Clara University and also earned a master's degree in electrical engineering from the university.

At IBM he advanced rapidly through technical and management positions in research, and in 1967 he was appointed director of IBM's communications laboratory in Research Triangle Park, North Carolina. In 1970 he was appointed director of IBM's San Jose and Menlo Park development laboratories.

Throughout the 1970s, Jack held senior leadership positions in a number of IBM technical organizations and was named a corporate vice president in 1980. He became an IBM senior vice president in 1982 and throughout the remainder of the 1980s earned a number of IBM executive appointments, including member of the corporate management board, leader of worldwide development and manufacturing, member of the board of directors, vice chairman of the board, and member of the executive committee. He was elected IBM president in 1989 and was named vice chairman in 1993.

Jack was responsible for the engineering, development, and manufacture of all semiconductor components for IBM products and led one of the largest semiconductor operations in the world. In the 1980s he guided IBM's investment in Intel, as well as its alliance with Hitachi. He also helped bring the United States to the forefront of semiconductor research by helping form an industry-government semiconductor alliance called SEMATECH.

He was chief development executive for IBM's disk file products and was responsible for the development of magnetic tape and mass storage products—including the IBM 3850, the world's first commercially available large-capacity magnetic mass storage subsystem.

In the early 1990s, Jack helped shape IBM's alliance with Apple and Motorola to produce a desktop computing system that combined IBM's hardware leadership with Apple's software expertise. The result was the PowerPC microprocessor, which became the basis for Apple computers from 1994 to 2006 and remains an architecture family at IBM that powers everything from enterprise-class servers of all sizes to video game consoles and a host of embedded computing applications.

In 1992, Jack became the first IBM leader to chair National Engineers Week (today known as eWeek), a coalition of more than 100 professional societies, corporations, and government agencies dedicated to ensuring a diverse and well-educated future engineering workforce by sharing with young students the benefits of math and science studies and the pursuit of technical careers.

Jack also demonstrated his commitment to diversity in the technical professions by serving on the board of directors of the National Action Council for Minorities in Engineering.

His other outside activities included the following: trustee of Santa Clara University; fellow of the Institute of Electrical and Electronics Engineers; fellow of the American Academy of Arts and Sciences; member of the board of directors of Olin Corporation; member of the board of directors of Aetna Life and Casualty Company; member of the board of directors of the National Association of Manufacturers; member of the board of directors of In Focus Systems; member of the board of directors of Taligent, Inc.; member of the Massachusetts Institute of Technology's Visiting Committee for Sponsored Research; and director of Parsons Corporation.

Jack authored four technical papers and earned four IBM patents, all involving the development of apparatus and devices for magnetic storage technology. He was elected to the National Academy of Engineering in 1984 for his outstanding engineering, technical, and management leadership in applying leading-edge computer technology to innovative data processing products.

On the personal side, Jack was a trusted mentor and cherished friend. Most of what I became at IBM was because of him. He understood the value of technology to IBM's business, and he saw the promise of technology in helping chart a better world.

During the keynote speech at a major computer trade show in the early 1990s, Jack made this comment about what to expect from ever-advancing technology: "If you can think of it, it will probably happen."

His widow wrote that:

> Jack also shared his talents and good fortune as a philanthropist. He worked with many organizations including The Special Olympics, Literary Council, Parkinson's Institute, National Cancer Society and the United Way to name a few."
>
> He will remain in the hearts of many as a peaceful, intellectual leader and mentor who was happiest when he was with his family either on a family vacation, at a family dinner, a ball game, teaching a math lesson, or debating a political issue with one or all of his five children. He also thrived on mentoring young engineers in the college environment at Santa Clara University and other institutions."

He is survived by his wife Carmen and five children as well as twelve grandchildren. His children are Cyndi Kuehler, Daniel Kuehler, Christy Kuehler-Chappell, David Kuehler, and Michael Kueler.


Ralph Landau

RALPH LANDAU

1916–2004

Elected in 1972

"For contributions and leadership in development, engineering, and marketing of new chemical processes."

BY P. L. THIBAUT BRIAN

RALPH LANDAU died on April 5, 2004. The co-founder of Scientific Design Company, Inc., which later became the Halcon SD Group, he was probably the most gifted and successful chemical industry innovator of his generation. Under his leadership his company became the major world source of new petrochemical processes, contributing to about one-fourth of all new processes in the period between 1960 and 1985. Licensing of these technologies and design of the plants to produce them resulted in more than 400 plants in 40 countries.

Ralph Landau was born in Philadelphia, Pennsylvania, on May 19, 1916. He attended Overbook High School and developed a keen interest in mathematics and science. He then enrolled in the chemical engineering program at the University of Pennsylvania and was awarded a B.S. degree in 1937. With a Tau Beta Pi fellowship to attend any university, he enrolled in the doctoral program at the Massachusetts Institute of Technology. He attended the School of Chemical Engineering Practice and then completed his doctoral thesis, earning an Sc.D. degree in 1941.

Dr. Landau then joined the M. W. Kellogg Company as a process development engineer. In 1943 he was asked to transfer to Kellex Corporation, a Kellogg subsidiary working on the Manhattan Project. As head of the chemical department, he worked with highly skilled engineers, including Harry Rehnberg, to design and run a plant used in the production of very concentrated uranium-235. He returned to Kellogg in 1945 but left in 1946 when he and Harry Rehnberg founded Scientific Design Company. He was executive vice president of Scientific Design from 1946 to 1963, when he became president of Halcon International, Inc., the newly formed holding company for Scientific Design (for engineering and licensing), Catalytic Development Corporation (for manufacturing), and SD Plants (for construction). He became chairman of Halcon in 1975 and continued in that post until Halcon was sold to Texas Eastern Corporation in 1982.

Scientific Design was founded with the objective of improving petrochemical processes, and a major early success was the production of terephthalic acid, the principal raw ingredient in polyester fiber, by bromine-assisted oxidation of paraxylene. The process was sold to Standard Oil Company of Indiana (now Amoco) and today accounts for most of the worldwide production of terephthalic acid. Another major success was an improved process for the production of propylene oxide, which is used in polyurethane foams and rigid polymers. This development was exploited by the formation in 1967 of Oxirane Chemical Company, a joint venture with Atlantic Richfield. Halcon's interest was purchased in 1980 by Atlantic Richfield, and Oxirane became part of Arco Chemical, which became the world's leading producer of propylene oxide. Other Halcon technology developments include ethylene oxide, ethylene glycol, maleic anhydride, acetic anhydride, polyisoprenes, and chlorinated solvents. Dr. Landau held numerous patents in his own right, in addition to more than 1,400 held by Halcon and its subsidiaries.

When Halcon was sold to Texas Eastern Corporation in 1982, Dr. Landau began an academic career to study the political and economic environment necessary to encourage technological innovation. At Stanford University he became a consulting professor of economics, a senior fellow at the Stanford Institute for Economic Policy Research, and associate director of the Center on Employment and Economic Growth. He was also a fellow at Harvard's Kennedy School of Government. He authored more than 143 papers and nine books.

Dr. Landau had a genuine interest in education. He was a life member of the Massachusetts Institute of Technology Corporation, and a major gift from him enabled the construction in 1976 of a new building to house the MIT chemical engineering department. The department's new home was appropriately named the Landau Building. Dr. Landau served on the chemical engineering visiting committee from 1965 until his death, on the economics visiting committee for 19 years, and on several other visiting committees at MIT. He was the main force behind a new building for the Stanford economics department and the Stanford Institute for Economic Policy Research. He also served on advisory committees at Princeton University, the University of Pennsylvania, and the California Institute of Technology. He was a trustee of the University of Pennsylvania, where he supported two professorships, and in 1977 he was one of nine trustees who established the challenge fund for the Million Dollar Match alumni-giving program.

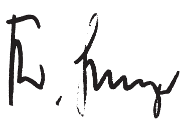
Dr. Landau's achievements have been highly acclaimed. President Reagan awarded him the National Medal of Technology in 1985, as one of its initial recipients. The American Section of the Society of Chemical Industry honored him with the Chemical Industry Medal in 1973 and the Perkin Medal in 1981. The American Institute of Chemical Engineers awarded him the Petroleum and Petrochemicals Division Award in 1972 and the Founders Award in 1982 and designated him Eminent Chemical Engineer in 1983. He received the Winthrop-Sears Award of the Chemical Industry Association in 1977, the Newcomen Society Award in 1978, the Chemical Pioneers Award of the American Institute of Chemists and the New Jersey Science/Technology Medal in 1981, the John Fritz Medal of the United Engineering Trustees in 1987, the Othmer Gold Medal of the Chemical Heritage Foundation in 1997, the 2000

Petrochemical Heritage Award presented by the Chemical Heritage Foundation and the Founders Club, and the Lifetime Achievement in Entrepreneurship and Innovation Award of the Lester Center at the University of California at Berkeley in 2003. He received honorary Sc.D. degrees from Polytechnic University of New York, Clarkson University, Ohio State University, and the University of Pennsylvania.

Dr. Landau was elected to the National Academy of Engineering in 1972 and served as NAE vice president from 1981 to 1990. He received the NAE Founders Award in 1994. In 1988 Dr. Landau was elected a foreign member of the Royal Academy of Engineering (United Kingdom). He was a fellow of the New York Academy of Sciences and the American Academy of Arts and Sciences, and in 1996 he was elected to the American Philosophical Society.

On July 14, 1940, Ralph Landau married Claire Sackler, and they had a daughter, Laurie J. Landeau. Claire earned a doctorate in sociology, and Laurie earned a doctorate in veterinary medicine. Ralph enjoyed swimming and had a pool at his house on Long Island, where he also had a 25-foot motorboat. He also enjoyed opera and subscribed to the Metropolitan Opera for many years.

Ralph Landau was a superb chemical engineer, a legendary entrepreneur, and a very generous philanthropist. He will be sorely missed by his many friends and colleagues and by legions of others whose lives he touched.



KURT H. LANGE

1919–2009

Elected in 1988

"For outstanding contributions in developing and understanding deformation processes, and for leadership in education and research for manufacturing."

BY A. ERMAN TEKKAYA AND EKKEHARD RAMM

ON THURSDAY, JULY 30, 2009, KURT LANGE went to work in his office at the Institute of Metal Forming Technology of Universität Stuttgart, as he had done for the past 46 years. On Friday morning he started to feel unwell, and the following day, August 1, he passed away. The metal-forming community has lost one of the most prominent figures in its field.

Kurt Lange was born on December 13, 1919, in Osnabrück, Germany, the son of a photographer. He studied mechanical engineering from 1939 to 1948 at Technische Hochschule Hannover and Braunschweig. His university life was interrupted between 1940 and 1945 by the Second World War when he was conscripted into military service with the artillery. During this period he came into contact with weapons, such as steel cartridges, that were produced by metal-forming processes.

The war period shaped his character considerably. His immense support of international collaboration and of academics in trouble worldwide in later years is probably a result of this time. His book, *Flowers at the Roadside: A Life After Survival*, also contains reflections of this emotional period. He recalled the time when he was involved in heavy fights, was wounded, became a prisoner of war, and saw the most inconceivable incidents; he remembered the crying mother beside her two dead children somewhere in Russia in August of 1943 and wrote, "I hated the war and I hated the world in which this could happen and would happen again and again. I hated myself."

In 1949 he started as personal assistant to Professor Otto Kienzle at the Research Unit Forging of Technische Hochschule Hannover. He wrote his doctoral dissertation in 1953—"Accuracy in Forging with Hammers"—and was promoted to leading engineer of the forging research unit. Four years later he completed his habilitation thesis titled "Forging." Habilitation is the highest academic degree in teaching and research and can be earned after obtaining a Ph.d. It requires the candidate to write a thesis based on independent scholarship which is reviewed and defended in a process much like that for a Ph.d. He gave lectures in Hannover on forging and also at Technische Hochschule Karlsruhe titled "Machines and Tools of Metal Forming Technology." At the end of 1957 he joined Daimler-Benz AG in Stuttgart-Untertürkheim, and two years later he became head of the forging department.

In March 1963 he was appointed as the chair for metal-forming technology at Technische Hochschule Stuttgart, which turned into Universität Stuttgart a few years later. Under his leadership, the chair for metal forming evolved to become the Institute of Metal Forming Technology, and since then over 110 doctoral promotions and habilitations have been completed under his supervision. More than 10 of his students became professors, and they, in turn, had several students who became professors as well.

Through Kurt Lange's dedicated and diligent systematic work, a "Lange School of Metal Forming" was established that is characterized by fundamental and novel research. He developed the scientific principles of numerous metal-forming processes such as cold forging and forging of powder parts, developed new technologies such as computer-controlled radial forging, and contributed to numerical modeling of forming processes as well as the characterization of materials at large plastic strains. He compiled his findings in four volumes of *Handbook of Metalforming,* which still today is the standard knowledge source of forming technology. During his time the institute developed into the "Mecca of Cold Forging." Even after his retirement in 1988, Professor Lange continued to work in his office at the university until his last days.

Kurt Lange valued and supported national and international networking. He was founding member of the International Cold Forging Group (ICFG) in 1967. He served as its chairman from 1974 to 1978. He became a member of the International Academy for Production Engineering (CIRP) in 1966 and served as its president from 1985 to 1986. He was elected a foreign associate of the National Academy of Engineering in 1988. The German Forming Association (AGU) and the German Academic Group of Manufacturing took pride in having him as their member.

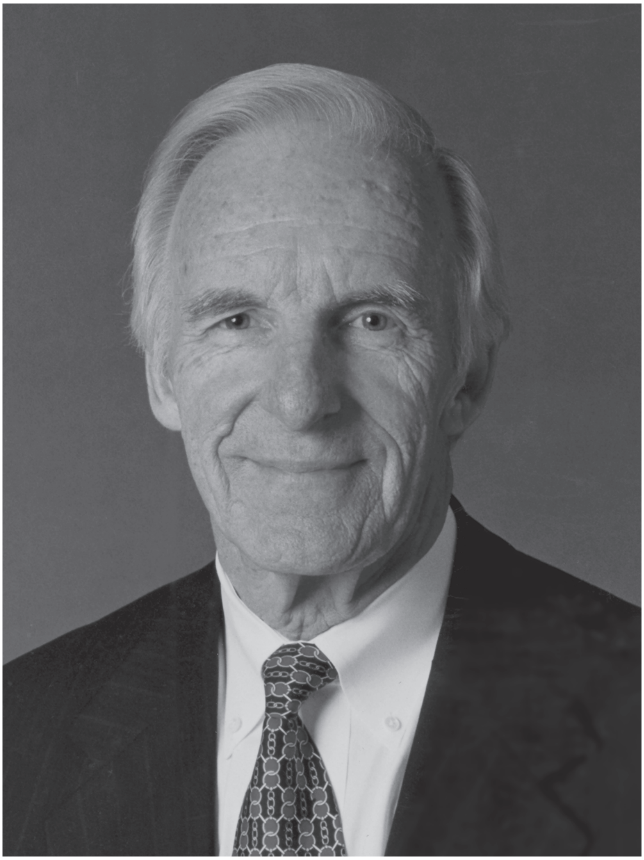
Kurt Lange shaped our knowledge of metal-forming technology through 15 books, published in German, English, Chinese, and Japanese, that serve as the reference source worldwide up to the present day. To our great surprise, on his 88th birthday he presented his new book, *Impact Forging* (Springer-Verlag: Berlin/Heidelberg/New York, 2008), which had just been released that very day. Referring to the great value in practice, a famous German industrial manager said about this book: "It is too good to be published"—meaning that now it could also be used by industry in other countries. However, due to Lange's conviction that scientific results should be available to everyone, publication of the book marked the start of another magnificent success story.

Various organizations have honored this great academic. He received the Society of Manufacturing Engineers Gold Medal of Manufacturing Engineering (USA), the Georg-Schlesinger-Prize of the State of Berlin, the Herwart-Opitz-Medal of the German Engineering Association (VDI), an honorary doctorate from Technology University of Budapest, and the International Prize for Research & Development of the Japan Society for Technology of Plasticity.

Professor Lange was an amateur pilot and enjoyed flying so as to see things from the top, as he was used to doing in his profession. He had to quit flying after an apoplexy in 1996. At that time he was 77 years old and I was just spending my sabbatical year in Stuttgart. After he recovered, he asked me to teach him to use the "stupid" computer since his handwriting was not good anymore after the stroke. He had received a used computer from his son and first learned word processing and finally e-mailing. Until his last days he was always the first to reply to the circular mails in the AGU association.

He loved his family dearly, and his wife accompanied him to most conferences. To our surprise, we learned from his family that he had established the Kurt & Ilse Lange Foundation in 2006, which has the aim to intensify manufacturing research by promoting students and young scientists.

Kurt Lange will remain in our memories as a fair, honest, and reliable colleague and friend. The National Academy of Engineering and the metal forming community have lost a great person and outstanding scientist, who initiated and coordinated fundamental developments with a remarkable commitment.



CRAIG MARKS

1929–2009

Elected in 1985

"For his advancement of the engineering art in automotive power trains, safety, aerodynamics, and emissions control, along with his concerns for the engineering profession."

BY TREVOR O. JONES

CRAIG MARKS, one of the world's foremost automotive engineers, died July 20, 2009, in Bloomfield Hills, Michigan. He was born on October 9, 1929, in Salt Lake City; the family moved to California, and he was educated at Berkley Hall in Beverly Hills.

Following receipt of his B.S., M.S., and Ph.D. degrees in mechanical engineering from the California Institute of Technology, Craig moved to Detroit in 1955 to join Ford Motor Company's scientific laboratories. In 1956 he moved across town to join the General Motors research laboratories as a staff engineer in the automotive engines department. In 1957 Craig received the Society of Automotive Engineers (SAE) Horning Memorial Award for his fundamental research on engine combustion noise. Craig's initial activities at GM distilled in him the need for a proactive pioneering spirit in the development of advanced-performance alternative power plants, including a high-performance-battery electric vehicle and a fuel-cell-powered van.

In 1968 Craig transferred to GM's advanced products engineering organization, where he was totally immersed in the development of emissions control systems. This activity was the highest engineering development priority at General Motors. Success in developing the industry's first durable catalyst using unleaded fuel was essential for GM's ability to meet the new exhaust emissions standards.

In 1972 Craig became executive assistant to the vice president of GM's engineering staff. In this position he was responsible for program and policy direction of the technical activities of a 6,000-person central engineering development organization that performed design, testing, and development operations and operated two major proving grounds for GM.

In the late 1970s the U.S. government promulgated a series of automotive standards for emissions, fuel economy, safety, noise, and repairability. GM elected to create an environmental activities staff and appointed Dr. Marks as its first executive director in 1979. This staff was responsible for corporate programs dealing with automotive emissions, safety, fuel economy, vehicle noise, and manufacturing plant environmental issues and for interaction with both the public and the government agencies concerning these areas.

In 1983, TRW, a major automotive supplier, recruited Craig to become its first vice president of engineering and technology, responsible for product technology, manufacturing, quality, purchasing, and information systems. Subsequently, Craig's responsibilities were expanded to include technical management of passenger restraint product and process development, including product integrity procedures, during the concept and start-up phase of a new business that supplies airbag systems, as well as seatbelts, to the worldwide automotive industry.

Owing to Craig's vast knowledge of automotive technology, he was recruited by Allied Signal in 1988 to become vice president of technology and productivity, responsible for policy and programs for the automotive sector's functions of manufacturing; quality; health, safety, and environment; public affairs; business planning; and direction of the Allied Automotive Technical Center.

In 1992 Craig essentially retired from the industry side of the automotive business and became visiting professor at the College of Engineering and School of Business, University of Michigan, Ann Arbor, and co-director of the Joel Tauber Manufacturing Institute, a program to establish new curricula and research activities for the engineering college, business school, and other units of the university, with extensive industry guidance, support, and interaction. Craig also served as president and as a member of the board of directors of Altarum in Ann Arbor and as a member of the board of directors at Intermap Technologies.

Having worked with Craig at General Motors and TRW and also having served on many committees of the National Research Council and SAE together, I quickly came to realize how thoughtful he was under a variety of intense situations. This admirable trait was particularly well demonstrated during our GM days, when we were striving to develop effective catalytic converters and airbags under extremely compressed time schedules. Craig was always soft spoken yet very convincing because of his extensive and in-depth knowledge of all aspects of automotive engineering.

One of his favorite pastimes was flying his own plane throughout the United States and Mexico for over 40 years with his lovely wife, Anne. Craig was also an avid tennis player, and his height gave him a distinct advantage. Both Craig and Ann signed up for the SAE Greenbrier Annual Tennis Championship, and each entered enthusiastically and played extremely well. A lifelong Christian Scientist, Craig was a member of the First Church of Christ the Scientist, in Birmingham, Michigan, and the Mother Church in Boston.

Craig will be sorely missed by his devoted wife of 37 years, Anne; his children, Gary Marks (Becky), Everett, Washington; Diane White, Fort Collins, Colorado; Marian Deming (John), Loveland, Colorado; his seven grandchildren, Lynn and Laura Marks, Heidi White, Joshua, Matthew, Ryan and Lindsay Deming; and sister-in-law Mary Hakola (Vern), Stuart, Florida.

ALBERT R. MARSCHALL

1921–2008

Elected in 1990

"For outstanding management, stressing highly professional leadership in all phases of vital large-scale worldwide facilities programs."

BY JAMES LAMMIE AND JACK BUFFINGTON

REAR ADMIRAL "MIKE" MARSCHALL, a native of New Orleans, Louisiana, and former chief of the Naval Facilities Engineering Command and the Navy Civil Engineer Corps and King Bee of the Seabees, died November 18, 2008, peacefully at his home in Alexandria, Virginia, with his wife of 64 years, Marie, at his side. His passing marked the end of a most distinguished career in construction and engineering that spanned more than 60 years.

Albert Rhoades Marschall was born in New Orleans on May 5, 1921. As a child of 9 years, a friend suggested he drop Rhoades as his parents called him and pick another name, so the two 9 year olds decided "Mike" was much better. Rhoades sounded too much like rose. He attended Tulane University for three years prior to entering the U.S. Naval Academy in 1941, graduating with distinction with the accelerated class of 1944. He was commissioned an ensign and assigned to the destroyer *USS Ross,* participating in the invasion of Leyte in the Philippines and the occupation of Japan.

In 1946 Marschall transferred to the Civil Engineer Corps and enrolled at Rensselaer Polytechnic Institute, where he received his B.S.C.E. and M.S.C.E. degrees. His first assignment in the Civil Engineer Corps was as assistant public works officer at the Yards and Docks Supply Depot in Davisville, Rhode Island. His next series of billets as a junior officer included duty with Amphibious Construction Battalion 2, the Bureau of Naval Personnel, the U.S. Naval Academy, and the Public Works Officer of the 12th Naval District.

CDR Marschall graduated from the Armed Forces Staff College in Norfolk, Virginia, in January 1961, served a tour as civil engineer corps detailer at the Bureau of Naval Personnel, and then accepted a two-year detail to the Bureau of Yards and Docks to serve as director of the Weapons and Other Support Division. In 1964 he became the public works officer for his alma mater, the U.S. Naval Academy, and on July 1, 1965, was advanced to the rank of captain.

In September 1966 Captain Marschall was ordered to Vietnam as commander of the 30th Naval Construction Regiment, and in June of the following year he was given additional duty as commander of the 3rd Naval Construction Brigade. He and his Seabees built airfields, roads, bridges, bunkers, and revetments for the troops at the front. Upon conclusion of his Vietnam duty, Marschall was awarded the Navy's Legion of Merit with combat "V" for meritorious service. The Society of American Military Engineers also honored him with the George W. Goethals Medal for his work in Southeast Asia. In October 1967 he returned to the United States to become commanding officer of the Southeastern Division, Naval Facilities Engineering Command (NAVFAC), headquartered in Charleston, South Carolina. In January 1970 he was promoted to rear admiral.

Immediately after his promotion, RADM Marschall was transferred back to Vietnam as deputy commander of the Pacific Division, NAVFAC, Southeast Asia, and officer in charge of construction in Vietnam. During this second tour in southeast Asia, he was responsible for supervising and monitoring $1.6 billion worth of U.S. Department of Defense construction. After returning to the United States, he received the Distinguished Service Medal "for exceptionally meritorious service to the government of the United States in a duty of great responsibility."

In May 1971, RADM Marschall reported as director of shore installations in the Office of the Chief of Naval Operations. Sixteen months later he was detached for duty as vice commander and shortly thereafter as commander of the Naval Facilities Engineering Command and chief of civil engineers.

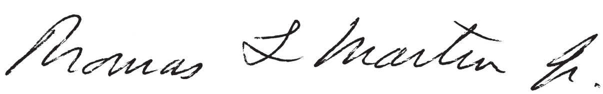
During the years Mike Marschall was chief, the command became heavily involved in constructing a dedicated support facility for the new Trident missile launching submarines. In Bangor, Washington, NAVFAC launched an extensive multiyear construction refit, training, missile processing, and logistics support for the Navy's Trident program. By the time RADM Marschall stepped down as commander, the Naval Facilities Engineering Command had obligated over $400 million for Trident-related facilities. In addition to Trident construction, the command focused a great deal of effort on building and modernizing naval hospitals during the mid-1970s. The most prominent of these hospital modernizations involved renovation of the National Naval Medical Center and construction of the Uniformed Services University of the Health Sciences, both in Bethesda, Maryland.

RADM Marschall closed out a 36-year naval career and retired in May 1977. The chief of naval operations awarded him a Gold Star in lieu of a second award of the Distinguished Service Medal for his exceptional service as commander of the Naval Facilities Engineering Command.

Soon after retirement, RADM Marschall became vice president of the George Hyman Construction Company, and in 1979 he returned to the public sector as commissioner of the Public Building Service for the General Services Administration. As commissioner he was responsible for the design, building, leasing, operation, and maintenance of most federal buildings in the United States. Following this position, he served on the board of directors of Parsons Brinckerhoff, Inc., from 1983 to 1994 and on the board of Parsons Brinckerhoff

Construction Services from 1994 to 1997. He was a member of almost every organization known in the world of engineering and construction.

RADM Marschall is survived by the wife of 64 years, Marie, and their five children, 13 grandchildren, and two great-grandchildren. This giant in the engineering and construction industry was loved and respected by everyone. Even 30 years after his retirement from the Navy his advice was still sought regularly by many flag officers on active duty. He will be sorely missed.



THOMAS L. MARTIN, JR.

1921–2009

Elected in 1971

"For creative application of modern communications technology to advance engineering education."

BY JOHN L. ANDERSON

TOM MARTIN died on October 8, 2009, in Irving, Texas. He retired after serving as president of Illinois Institute of Technology between 1974 and 1987. Other academic leadership experiences included Dean of Engineering at the University of Arizona, University of Florida and Southern Methodist University. He received his bachelor's and master's degrees from Rensselaer Polytechnic Institute. During World War II he served in the Army, rising to the rank of captain and was awarded a Bronze Star. After the war he attended Stanford University where he received his Ph.D. He received honorary doctorates from RPI and SMU. He was a Fellow of IEEE and an honoree in the Hall of Fame of ASEE. He was a member of the 1970 commission sponsored by the U.S. Agency for International Development (USAID) that was chaired by Frederick E. Terman and recommended the establishment of the Korean Advanced Institute for Science (now KAIST). He is survived by his second wife Millie, two brothers, two children, and two grandchildren.

Dr. Martin was a pioneer in distance education and saw its potential in both primary and continuing (professional) education. At Illinois Institute of Technology he garnered financial support from corporations such as Motorola and A. Finkl & Sons to develop real-time video courses. He created IITV as a microwave-based distance education TV network that allowed students at remote locations to participate in live classroom discussion. IIT courses were delivered to many remote locations throughout the Midwest. Under his leadership, IIT became the first university to join the National Technology University. Today his vision of distance education is realized by online transmission using the Internet.

His passion and commitment were directed to the diversification of engineering and science education as it related to gender, race, and ethnicity. He correctly appreciated the changing demographics of the United States and the need to incorporate underrepresented minorities in the technical fields. In his first year as president of IIT, he partnered with his newly appointed admissions director, Nate Thomas, to develop a strategy to increase the undergraduate enrollment of underrepresented groups. The result was extraordinary–the enrollment of minorities rose to become 21 percent of the undergraduate student body, the enrollment of women increased by 150 percent, and the first woman received a varsity athletic letter during his presidency. He was an early advocate for the National Action Council for Minorities in Engineering (NACME).

Other notable achievements during his tenure as president of IIT include growth of the undergraduate student body by 40 percent, development of a strong ROTC program in the three major military branches, and programs to achieve efficient waste and energy management on the campus. He sought to "green" the university campus decades before the term became fashionable.

Martin's multidimensionality is evidenced by his authorship of eight books including the textbooks *Ultrahigh Frequency Engineering* (Prentice-Hall) and *Electronic Circuits* (Prentice-Hall), and the fiction book *Malice in Blunderland* (McGraw-Hill), which satirizes the ineptitude of many non-profit institutions.

Tom Martin was a visionary. He appreciated very early the potential role of communications technology in education and the need to reach out to all elements of our society in order to create the innovative people that advance society. He was an academic leader without pretense and continually questioned the *status quo*. Today's leaders of the engineering profession, corporate and academic, are indebted to him.

DAVID MIDDLETON

1920–2008

Elected in 1998

"For statistical communication theory and applications."

BY THE FAMILY OF DAVID MIDDLETON
AND JOSEPH W. GOODMAN

DAVID MIDDLETON, a physicist whose original research led to major advancements in the understanding of communication systems—from radar during World War II to the wireless communication systems of our present age—died on November 16, 2008, in New York City. He was 88.

Born in New York City in 1920, Dr. Middleton graduated from the Harvey School in 1934 and Deerfield Academy in 1938. He received his undergraduate and graduate degrees in physics from Harvard College (A.B., 1942, summa cum laude) and Harvard University (M.A., 1945; Ph.D., 1947).

Dr. Middleton was a scientist, a researcher, and a founder of the field of statistical communication theory. He devoted his entire career, spanning six decades, to studying signal processing and the transfer of information from one point in space-time to another, with numerous applications in radar, underwater listening devices, satellite technology, and signal processing.

His career began in 1943 at the Harvard Radio Research Laboratory as special research assistant to Professor J. H. Van Vleck (later a Nobel Laureate in physics), with whom he took his Ph.D. in 1947. Together, Dr. Middleton and Van Vleck (and simultaneously but independently, D. O. North at RCA Laboratories) developed the matched-filter principle critical to data communications and an enduring concept in the field today. In 1943 Dr. Middleton began the analysis of signals and noise passing through nonlinear devices, such as the "chaff," or aluminum strips, used to jam radar signals in order to protect American ships and aircraft from detection by the enemy.

As an assistant professor of applied physics at Harvard University (1949–1954), he introduced new courses on statistical communication theory and processing signals in noise. He also served as adjunct professor at Rensselaer Polytechnic Institute and the universities of Columbia, Johns Hopkins, Texas, Rice, and Rhode Island, where he supervised a number of doctoral students and made major contributions with them.

From 1954 to 2008 Dr. Middleton was a consultant to universities, industry, and the federal government. During the Cold War era of the 1950s through the 1980s, Dr. Middleton's theoretical work for the government was applied to antisubmarine warfare systems, in particular to passive and active sonar systems to track Soviet submarines. During the détente of the 1970s, when U.S. and Russian scientists began pursuing joint projects, he served as scientific editor for several Russian texts in his field and made presentations in the former Soviet Union, where he was officially recognized and highly regarded in his field.

Published in 1960 and widely translated into many languages, Dr. Middleton's seminal work, *An Introduction to Statistical Communication Theory* (McGraw-Hill; reprint editions with new author's prefaces issued in 1987 by Peninsula Publishing and 1996 by IEEE Press, now distributed by Wiley-IEEE Press), played a major role in integrating statistical methods into the education of engineers in communications, radiolocation, and related fields. Leon Cohen, professor of physics at Hunter College in New York, has used the book since graduate school 45 years ago. He writes: "Dr. Middleton's book is one of those texts that is so extraordinary for its clarity and depth that one marvels at it and the author. It is perhaps the greatest book ever written on noise, probability theory, and stochastic processes. . . . The classic book on noise, written with style and elegance, [it] covers a panoramic view unmatched by any other publication."

Dr. Middleton's work in statistical communication theory included the handling of random processes and the application of decision theory to signal detection and estimation. In statistical physics he contributed to a greater understanding of propagation and scattering in random media, with an emphasis on the underwater environment. After 1968 his work expanded to include electromagnetic compatibility, with particular attention to non-Gaussian noise and interference models, and non-linear signal processing for man-made and natural electromagnetic and acoustic environments.

He served on the U.S. Naval Advisory Research Committee (1970–1977) and the Scientific Advisory Board of the Supercomputing Research Center, Institute of Defense Analysis (1988–1991).

Dr. Middleton published a second book, *Topics in Communication Theory* (McGraw-Hill, 1965), and over 170 papers. Significant among them is his 2002 paper, "New Results in Applied Scattering Theory," which contains a synthesis of his methods for determining the statistical characteristics of non-Gaussian noise affecting signal reception. These methods have contributed to solving long-time, complex problems in radar, sonar, and radio astronomy, as well as problems where non-Gaussian noise is often encountered.

At the time of his death, he was actively working on his last book, *Elements of Non-Gaussian Statistical Communication Theory: A Space-Time Treatment* (to be published posthumously). A sequel to his first book, it summarizes his work of over 65 years in statistical communication theory and presents results from more recent research gained by adding non-linear effects and time analysis to earlier methods.

Dr. Middleton was a fellow of several scientific societies, among them the Institute of Electrical and Electronics Engineers (IEEE), the American Physical Society, the Acoustical Society of America, the American Association for the Advancement of Science, the New York Academy of Sciences, and the

Electromagnetics Academy. He was elected to membership in the National Academy of Engineering in 1998. He received numerous prizes and awards for his work. In August 2008 the IEEE and Princeton University hosted a symposium in honor of his long and distinguished career.

For a well-balanced life, David Middleton believed in the importance of cultivating the arts and humanities as well as math and science. He was meticulous in crafting the prose for his books and papers, believing there was no excuse for scientists and engineers to be poor writers. In addition, he read widely, collecting books on history, philosophy, biography, art, and music. He listened to music from the Classical and Romantic eras and played the piano—especially Beethoven, Schubert, and Chopin—expertly and with great dexterity and feeling. Over the years he drew many elegant line drawings of imaginative scenes and characters. He loved the Cape Cod seashore, where he spent part of every year with his family, playing tennis and enjoying the ocean and walks in nature. He could tell outrageous puns and was very fond of cats.

Dr. Middleton married Nadea Butler Middleton in 1945 and raised a family with her in Cambridge and Concord, Massachusetts. They divorced in 1971. He leaves his second wife, Joan Bartlett Middleton of New York City, and four children from his first marriage, three stepsons, a niece, and three granddaughters.


CALIFORNIA REPUBLIC

JOSEPH MILLER

1937–2007

Elected in 1991

"For contributions to advanced high-power lasers and optical systems."

BY PETER STAUDHAMMER

JOE MILLER was born on April 3, 1937, in San Francisco, California, to parents of modest means. His father was a carpenter, later to become a general construction contractor. Eventually, the family moved to Los Angeles, where Joe grew up together with his three siblings. The family prized education and provided both nurture and a balance of love and competition that gave flavor to Joe's personality and success.

Joe attended Van Nuys High School, where he became interested in math, science, and engineering. In 1954 he entered the University of California at Los Angeles (UCLA) as a freshman engineering student. For the first two years, his record at UCLA was unremarkable. From his transcript one would conclude that Joe might just be average. Not so! Near the end of his second year, Joe applied for a job on a state-supported air pollution project, under the leadership of Professor Sam Yuster. Though there were many applicants and Joe's academic record did not stand out, he came through as brilliant in his interviews. So he was asked to join the project team. Sam Yuster was a good principal investigator, but he was an absolute genius at knowing how to teach about life and how to motivate—and motivated Joe became. His academics improved to practically straight A's for the rest of his stay at UCLA; he wrote papers, he made innovations, and he became a first-rate engineering leader.

(A parenthetical note here that I know Joe would want me to include. At the time, Professor Yuster had been at UCLA for just a few years, and he headed relatively modest projects. Yet within that short time span, he produced three graduate students who would later be elected to membership in the National Academy of Engineering. Sadly, Professor Yuster passed away from brain cancer in 1958, a few years before the NAE was chartered. Still three engineers, including Joe Miller, all know that they owe their success to the care that Professor Yuster gave them.)

With the passing of Professor Yuster and the lack of sustained state funding, the principal graduate students started to seek different specializations. Joe received his B.S. in engineering (at the time UCLA had no departments and awarded only general engineering degrees—a practice that now is being revived with the many multidisciplinary centers at a lot of U.S. campuses). Joe elected to pursue nuclear engineering, which at the time seemed very promising. He received his M.S. degree in engineering, with nuclear specialization.

Meanwhile, we discovered a match for Joe, a young lady, Judy Peckler, who worked as an administrative assistant in the dean's office, which conveniently happened to be located on the same floor and hallway as the research lab where Joe worked. It seemed that introducing them to each other would be a good idea. To my surprise, the relationship flowered, and Judy and Joe were married in 1959.

Following a short enlistment in the U.S. Army, Joe returned to UCLA to get a Ph.D. in general engineering, with a nuclear option, which he was awarded in 1961. Armed with a Ph.D. in the nuclear field, Joe joined Atomics International and worked for eight years on liquid metal reactors, an advanced class of power reactors cooled with liquid alkali metals. Unfortunately, these reactors became a victim of federal budget pressures and environmental litigation. Joe still had his job at Atomics International, but he started to look for one with more immediate potential. As it happened, a job was waiting for him at TRW, Inc. He joined TRW in 1964.

The Apollo Mission to land a man on the Moon and safely bring him back was started in 1961. The mission required a variable-thrust, deep-throttling, high-performing rocket engine to achieve a soft landing. The propellants chosen were nitrogen tetroxide (N2O4) and a 50/50 mixture of hydrazine (N2H4) and unsymmetrical dimethyl hydrazine (N2H2(CH3)2). This is a hypergolic propellant combination that ignites within less than a tenth of a millisecond following contact of the propellants and immediately releases gaseous reaction products at the interface, preventing further mixing.

An ingenious concept for achieving a variable-thrust engine was invented by G. W. Elverum at the National Aeronautics and Space Administration's (NASA) Jet Propulsion Laboratory a few years earlier. It employed a variable-area injector and a pair of variable-area cavitating venturis, all mechanically slaved together and actuated by an electromechanical actuator. This control architecture separated the injection area control (which controlled combustion efficiency) from propellant flow control (which controlled flow rate and propellant residuals). TRW proposed to develop the Elverum engine.

Recognizing the difficulty of developing a 10:1, deep-throttling engine, NASA awarded a primary development contract in 1962 to Rocketdyne and a backup to TRW in 1963. By 1964 it became clear that the variable-area injector–venturi combination had a better chance of succeeding, and TRW was awarded the sole contract to complete the development.

Joe Miller joined TRW Propulsion in 1964 and seamlessly became part of the LMDE development team. He had an excellent knowledge of engineering, he had learned a lot about combustion and fluid mechanics at UCLA, and he was an excellent project and personnel manager. He started out as staff to the chief engineer and in a short time was promoted to assistant chief engineer and eventually took the place of the chief engineer for the Apollo lunar descent engine. Joe was clearly too late to have much influence on the research phase, but his skills as a planner, a manager, and a new, inquisitive voice to question project decisions were invaluable. He was clearly one of a handful of leaders of the development project.

The development phase of the program lasted for five years, until 1968, when all significant specification requirements had been achieved. It was a most difficult development. We had to address a long list of issues that had never been dealt with up to that time: feed system and combustion stability over a 10:1 flow regime, very high combustion efficiency, compatibility with an uncooled combustion chamber, and many more. Still in five years the development was finished, just in time for qualification.

Originally the LMDE was to have two full-duration, unmanned, Earth orbital flights. One was canceled due to schedule and budget pressures. The other, though intended to fire for 500+ seconds, only received a three-second test at less than 10 percent thrust. Nevertheless, based on ground test data, the engine was pronounced by NASA as fully flight worthy. (Although Joe Miller and the rest of the TRW team objected, it turned out to be a good decision, saving both time and money.)

The next flight was *Apollo 11*, the first vehicle to soft land on the Moon, with Neil Armstrong and Buzz Aldrin. The flight to and from the Moon was uneventful, with the LMDE completing its job of soft landing. The only excitement occurred at the very end of the landing. Neil Armstrong did not like the boulder field that turned out to be his primary landing site, so he took an additional 15 seconds to select a different terrain. He nearly ran out of propellant.

The successful soft landing echoed around the world. All of us were proud of our achievement, which we thought had been done for the United States. The entire Apollo team celebrated, though politicians soon stepped to the forefront. The two-hour television broadcast from the Moon landing was seen by an estimated 500 million people around the world, up to that time the largest single TV audience. Also, July 20, 1969, was arguably the last day the United States was truly proud of itself.

The next flight, *Apollo 12*, was hit by lightening on liftoff from Cape Canaveral. All data channels, the normal communication to the ground, both to the controllers and the technical people, went blank for about 30 seconds, but the TV monitors showed propulsion and attitude control still holding. Communication was restored, and the mission ultimately turned out to be a success, including the flawless performance of the LMDE.

We all know about *Apollo 13*. During transit to the Moon, an oxygen tank in the service module exploded, leading to a loss of most of the oxygen and modifying the vehicle's thermal characteristics, resulting in a precipitous drop in cabin temperature. Also, all propulsion was disabled, except for the LMDE, which was then used to put the vehicle into an Earth-return trajectory. It was a six-day ordeal for the three astronauts, who huddled in the lunar ascent vehicle, with temperatures hovering near freezing. Still, with the help of the descent engine, the Apollo command service module was put into a correct orbit to return to Earth. The orbit correction required a burn behind the Moon, which was successfully accomplished under computer control, with no communication to Earth.

The rest of the missions, *Apollo 14, 15, 16*, and *17*, went smoothly, without a hitch. In all the LMDE soft landed 12 astronauts on the lunar surface and rescued the three-man crew of *Apollo 13*. An absolutely necessary part of the Apollo missions was the variable-thrust LMDE. It completed its part of the missions and more on *Apollo 13* without a flaw. At the time Joe was TRW's systems engineer for LMDE and was present in Houston in the technical resource room, where he gave advice on technical matters.

Joe also performed flawlessly as a leader within TRW. The total project staff peaked at 700 persons, with 250 engineers. This required a very broad approach to leadership. Joe established a structure to assign requirements and to get rapid feedback; he chaired planning meetings; he held frequent working meetings for the solution of specific technical issues; and he reported faithfully problems and accomplishments alike.

Following completion of the lunar program, Joe was promoted to laboratory director, with about 300 engineers and scientists with responsibility for propulsion, fluid mechanics, solid state physics, and applications of electro-physics and chemical laser development. In effect, he was now in charge of fundamental research for the entire Space and Electronics Group (S&EG). Other groups within S&EG were focused on major projects, whereas Joe was to lead advanced research.

Joe focused on two areas, most important to the future of S&EG: chemical lasers and solid state devices. Both were highly successful. Chemical lasers, based on fluorine, had been invented at the Aerospace Corporation a few years earlier in 1969. Joe's principal contribution was to build a competent staff, structure, and plan and to manage and secure funding for the development of useful products. Due to the high cost of fuel and the expense of development, the application of chemical lasers was restricted to the military, where the possibility for speed-of-light delivery of very intense energy concentrations led to military interest in high-energy weapons system applications. A laser produces coherent light that can be concentrated and focused to a vastly higher intensity than an incoherent beam. For instance, a 10-micron diffraction-limited coherent beam can be focused to an intensity factor of 108 higher than an incoherent beam. However, to achieve that amplification, a series of very difficult physics and engineering issues needed to be resolved. These issues are every bit as difficult to resolve as the ones Joe found in the LMDE—and this time Joe directed and contributed to the research that included:

- Creating a gain medium with an inverted population, where beam amplification is sufficient to add energy to the beam but not so high as to allow spontaneous emission to grow
- Removing the de-excited product very quickly, so that it does not reabsorb laser energy from the beam
- Building an optical resonator that causes lasing energy to build up. Usually this is an unstable resonator with one concave and one convex reflector that, with proper choice of focal lengths, causes the beam to "walk out."
- Building water-cooled mirrors and coatings to take the laser heat load

- Developing chemical pumps to maintain low-exhaust pressures
- Developing a model and balancing all flows, including energy flow, such that all requirements are balanced optimally and continually. Verify the model against test data.

Most of the above requirements needed to be resolved to support the analysis and design the laser. In most cases, basic physics data did not exist and had to be measured. Still, Joe's team made the fundamental measurements, designed the whole laser system, and balanced and optimized.

At this point, it is worthwhile to include a short tutorial on chemical lasers, as authored by Joe, some 15 years ago:

> "A chemical laser uses its own inherent reaction energy and needs no electrical augmentation. Reactants, including a fluorine-bearing oxidizer and fuel, are injected along with suitable diluents into a combustion chamber. The fluorine oxidizer is in excess of stoichiometric requirements. Combustion pressures range from 10 to 100 psi at temperatures in excess of 1500 K. This is sufficient to dissociate the excess molecular fluorine and to produce atomic fluorine. The atomic fluorine-bearing gas is then expanded through an array of supersonic nozzles to low pressure, low temperature, and very high velocity. Hydrogen, H2, or deuterium, D2, is injected between the fuel and the fluorine nozzles. Within the cavity, a second combustion stage occurs (this time between hydrogen or deuterium and fluorine) and in which a non-equilibrium, inverted population of hydrogen fluoride or deuterium fluoride is produced, from which in turn a laser beam can be derived."

Under Joe's leadership a number of chemical and other lasers have been developed at TRW, including pulsed HF and DF lasers, excimer lasers (exited dimer lasers that lase on KrF* or XeF* and, since they exist only in the excited state, they dissociate simultaneously with energy decay), free electron lasers, and solid state lasers. All hold promise for various applications.

Joe Miller was clearly a pioneer in high-power lasers and advanced optical systems. His contributions ranged from personal invention to innovative design and leadership of successful major engineering efforts. He was responsible for achieving a number of national milestones in combustion-driven chemical lasers: the first such laser in 1970, the first high-power operation (BDL) in 1973, a higher power laser (NACL) in 1975, beam propagation and dynamic target tests, the first high-power repetitively pulsed chemical laser in 1980, a megawatt-class laser (MIRACL) in 1980, operations at the National High Energy Laser Test Facility at White Sands, and the lightweight, high-beam-quality, high-power, cylindrical, megawatt-class, chemical laser (ALPHA) in 1989. Since 1994, he was a leading contributor to the development of non-linear optical phenomena, applied to high-power optical projection systems, space-based imaging and continued research in high-energy lasers.

As a manager and leader, he built nationally recognized organizations that have pioneered in both rocket propulsion and high-power lasers. Since 1981 he was responsible at TRW for applied physics research. Under his leadership several, classified national space payloads were and are continuing to be developed.

As Joe stated in 2007, "These areas tend to involve a wide range of physics, chemistry, and engineering disciplines. I also have a relatively broad technical knowledge involving nuclear reactors, combustion, optics and optical phenomena, test and laboratory facilities, and have background in the management of innovation and the development of complex technologies and products." Joe indeed did have the fundamental knowledge. He held six patents and authored 25 technical publications (in addition to numerous classified papers). He generally shunned awards, preferring to win contracts in the classified field. It needs to be added that he was also an outstanding motivator and much of his success stemmed from that.

Dr. Miller retired from TRW in 1993. All his life he believed in the virtue of service to society—to give back to society of the gifts he received from the prior generation. True to his nature, in 1997 he joined UCLA as an adjunct professor. He designed a course he titled "The Art of Engineering Endeavors," which covered the essence of engineering design, along with moral, ethical, and environmental aspects of engineering design and management. He emphasized that engineering was a social endeavor and that great engineering accomplishments were the direct results of collaboration—thus was Joe's dedication.

Joe was also a great family man and a philanthropic contributor to his community. From his youth on, he was an accomplished violinist, for the last few years playing with the Pacific Palisades Symphony Orchestra as the concert master. Love also prevailed, as he remained married to his first love, Judy, whom he had met at UCLA. Joe and Judy raised three children, Elizabeth, Mona, and David, who in turn are raising five grandchildren. Elizabeth is a successful architect, Mona is a doctor of veterinary medicine, and David is an attorney. All three live in the San Francisco Bay area, while Judy lives in Tarzana, California. In addition, Joe is survived by his mother, Ida Major, and three siblings.

In June 2007 Joe called and enlisted me to sponsor him on an ALS (Lou Gehrig's disease) bike-a-thon. About two weeks later, on July 5, 2007, he took his bike on the road to get in shape for a 100-mile ride. Tragically, he was struck by an automobile and was killed instantly.

Joe certainly lived a good, full life—a life of visionary leadership and service to society. He made very significant contributions to national programs and laid the research foundations for commercial applications, and he deserves our admiration. Perhaps it was Professor Yuster who had a major impact on him, but Joe, in turn, had an equal impact on others around him. Many of us who knew him well will remember him as a gentle giant—as an engineer, a leader, a musician, and a dear friend.

May God be with you, Joe. You gave us a lot!

WILLIAM W. MOORE

1912–2002

Elected in 1978

"Pioneering in the field of geotechnical engineering contributing to knowledge of earth sciences."

BY ROBIN K. MCGUIRE

WILLIAM WALLACE (BILL) MOORE passed away on October 23, 2002, at the age of 90. Born in Pasadena, California, in 1912, he attended the California Institute of Technology, where he received a B.S. degree in 1933 and an M.S. degree in 1934, both in civil engineering. Following graduation he worked for several years for the U.S. Coast and Geodetic Survey and for other consultants before he founded the consulting engineering firm of Dames & Moore in 1938, in partnership with Trent Dames, another CalTech graduate.

Bill realized early on that structural engineers designing foundations for buildings and retaining walls needed to know more than soil mechanics to make informed decisions and recommendations. At the time, in 1938, soil mechanics consisted of determining soil characteristics such as grain size and shape, density, and water content that could be used to estimate the bearing capacity of the soil under load. He recognized the need for soil engineering, by which he meant the analysis and design of alternative foundations (e.g., spread footings, wood piles, steel piles, and concrete piles), as a basis for making decisions on estimated settlements, ease of construction, integration with the superstructure, and cost. In pursuing Bill's vision of soil engineering, Dames & Moore specialized in soil testing, sampling, and analysis that provided information to support the evaluation of alternative foundation designs.

Under Bill's supervision, new soil sampling methods were invented, developed and used on project sites. These included leaf samplers, ring samplers, and piston samplers that could be applied in a drill hole. By today's standards, these tools did not produce "undisturbed samples," but he characterized the samples as "sufficiently undisturbed to make laboratory tests usable" in determining soil strength. Dames & Moore patented one of their early leaf samplers and sold versions of it to other engineers. The sampler is still in use, and its fundamental design is still considered one of the best for obtaining quick, down-hole soil samples.

During World War II, Bill was a consultant to the Naval Construction Battalion in the Middle East. The challenge was to develop a soil-sampling technique for Seabees moving into an area ahead of occupying armed forces that would enable the Seabees to build landing strips for airplanes quickly. Some landing strips had to be built on beach sands, where construction decisions had to be made in a matter of hours. Bill developed a portable ring sampler/analyzer that could be run by hand, and the results could be used to make immediate engineering decisions on the suitability of existing materials for airstrips and on compaction techniques for building airstrips quickly.

Bill also developed methods of calculating allowable loads on pile foundations that accounted for both end bearing and skin friction of the piles. A strong component of these methods involved testing, both of test piles and actual piles used in foundations. For the latter, settlement measurements were taken to substantiate and improve estimation techniques. Bill realized that standard penetration tests and pile-driving data did not necessarily indicate the ability of a pile to carry static load for long periods of time.

Bill was a strong proponent of a close relationship between the soil engineer and the contractor to ensure that recommendations on foundations would not be made without field experience. In the 1950s and 1960s, newly employed engineers at Dames & Moore were obliged to spend time in the soil laboratory and on field-drilling and soil-sampling jobs. With his penchant for field experience and client contact, Moore became known as "Mr. Outside" at Dames & Moore; Trent Dames fulfilled the role of "Mr. Inside," the one who handled the firm's management and administration.

From a two-person firm in 1938, Dames & Moore grew to be one of the preeminent geotechnical engineering firms in the world. By 2000, the company had grown to 6,000 employees and 100 partners, reflecting the importance Bill placed on innovative and imaginative solutions to engineering problems and on motivating employees to pursue those solutions. He gave his employees wide latitude to pursue new business areas, whether in different parts of the world or in new engineering applications related to site investigations. As a result, his staff was incredibly loyal. He was a strong leader and mentor who help mould the careers of young engineers with an ethic of responsibility and informed decision making for clients.

During World War II, Bill had been a consultant to Standard Oil of California in its operations in Saudi Arabia, assisting with the siting and geotechnical development of the first refinery at Ra's al Tannŭrah. This experience led to consulting with other oil companies in the Middle East following the war. In the mid 1950s, he recognized the potential of working for other industries internationally, and Dames & Moore expanded its efforts to obtain overseas projects, frequently supporting U.S.-based clients in building overseas facilities.

Bill placed a high priority on building client relations, because, he said, the easiest job to obtain is a repeat job from a satisfied client. He did not have a sales department in his engineering firm because he believed engineers were the best salespeople for their work. His advice to them was to sell engineering services based on the problems to be solved, not on the basis of competitive bidding or lowest cost. His favorite example was that, although any engineer could develop a quick, cheap, generic design for a foundation, that design would be more conservative and expensive to construct than the design by an engineer who could perform site tests and design a foundation for the specific conditions at hand. The total cost of the site-specific design and foundation construction would be less than that of the generic design and foundation construction, and it was the engineer's role to explain the cost savings in construction and overall life cycle to a potential client.

As the firm's reputation grew, Bill himself developed a reputation as an innovative soil engineer, and this was reflected in his election to the presidency of many engineering organizations: the Structural Engineers Association of California (1947), San Francisco section of the American Society of Civil Engineers (1957), American Consulting Engineers Council (1964), and Federation Internationale des Ingenieurs Conseils (1970). For the latter organization, which is based in Europe, he was the first American to serve as president. In 1981, he was the first recipient of the Arthur M. Steinmetz Award from the American Consulting Engineers Council, in recognition of his distinguished career in consulting engineering. For his contributions to geotechnical engineering, he was elected to the National Academy of Engineering in 1978. In professional organizations, he continued to promote his view that consulting engineers are expert advisors and must remain independent of any particular construction technique, material, or design method. In this respect they differ from engineers working for a particular industry or fabricator, whose job is to promote certain solutions to engineering problems. Bill believed that engineering educators should promote an understanding among students that consulting engineers are responsible for evaluating a wide range of alternative solutions when working for clients and that consulting engineers must aggressively guard their independence and ethical reputations.

In addition to engineering consulting, Bill Moore had a deep interest in public policy decisions and how engineers could contribute to the making of those decisions. Most of the issues that affect our lives have an engineering component, he said, but most engineers, because of training or psyche, do not have the patience or temperament to participate in the often lengthy negotiations associated with developing public policy regarding the environment, land use, health regulations, and so on. He was an early advocate of sustainable development, but had little patience for those who took extreme positions that were not economically viable or who had a very short-term perspective to maximize economic return. "The engineer has to listen to other people and help bring things together toward a workable consensus," he said. "The process requires some compromises, while keeping in mind the ultimate objective—a sustainable world."

Mr. and Mrs. Moore are survived by their three children, Susan, Bill, and Roy, and eight grandchildren.

Bill and Susan wrote that:

> While Bill was a consummate professional and world traveler, he was also a devoted husband, father and grandfather. Genie and Bill had three children and eight grandchildren. His children Susan, Bill, and Roy remembered their father's deeply held values and that their parents passed on the importance of honesty, integrity, and service–"giving back"–to their children. Bill loved boating on San Francisco Bay and spent many happy and adventuresome hours with his family and friends on small boats.
>
> Bill was a natural leader, a fair and fierce competitor and a creative thinker. And he was not afraid to change his mind if someone else's idea was better in any situation. He enjoyed a vigorous and healthy exchange of ideas. The well known twinkle in his eye revealed his great pleasure with life.

MORRIS MUSKAT

1906–1998

Elected in 1983

"In recognition of pioneering work in establishing the basic concepts defining the flow of fluids in the earth and establishing the field of reservoir engineering."

BY JOSEPH E. WARREN

MORRIS MUSKAT was one of the truly great pioneers in the petroleum industry, who laid a sound analytical foundation for petroleum reservoir engineering by combining fluid mechanics with phase behavior. He died on June 20, 1998, at the age of 92 in Pasadena, California.

Dr. Muskat was born on April 21, 1906, in Riga, Latvia, and he, with his family, migrated to the United States in 1911; he was naturalized as a U.S. citizen in 1914. Muskat attended Marietta College and Ohio State University, where he received B.A. and M.A. degrees. After teaching physics at Bowling Green University, he earned his Ph.D. in physics from the California Institute of Technology in 1929.

After graduating from CalTech, Morris joined Gulf Research & Development Company where he remained in various capacities until 1950. He took a one-year hiatus from Gulf, during World War II, to serve as chief of the Acoustics Division of the Naval Ordinance Laboratory, Washington, D.C. In 1951 he became technical coordinator of the Production Department, Gulf Oil Corporation in Pittsburgh, Pennsylvania. In 1961 he was promoted to technical adviser to the Executive Group of Gulf—a position he held until his retirement in 1971.

Morris Muskat was a fellow of the American Physical Society; a fellow of the American Association for the Advancement of Science; a member of the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME); a member of the American Petroleum Institute (API); and a fellow of the New York Academy of Sciences. He also served as distinguished lecturer for the Society of Petroleum Engineers (SPE) in 1962–1963, as member of the U.S. delegation to the United Nations Economic Commission for Asia and the Far East (ECAFE) Symposium in Tokyo in 1965, and as chairman of the API's Committee on Petroleum Reserves (1955–1971).

Among the many honors he received were the API's Certificate of Appreciation (1965) and Special Scroll (1971), the SPE's Lester C. Uren Award (1969), the AIME's Lucas Medal (1953) and honorary (life) membership (1972), membership in the National Academy of Engineering (1983), and CalTech's Alumni Distinguished Service Award (1987).

Following the massive overproduction of oil in the 1930s and the subsequent low prices ($.10/barrel) that resulted in the virtual collapse of the U.S. oil industry, Muskat published his seminal book, *The Flow of Homogeneous Fluids Through Porous Media* (McGraw-Hill, 1937). This book, together with his later book, *Physical Principles of Oil Production* (McGraw-Hill, 1949), established the bases for petroleum reservoir engineering. The evolution of this discipline and the establishment of regulatory bodies such as the Texas Railroad Commission, plus the effective repeal of the "law of capture" (an 1875 judicial opinion that oil and gas were like wild animals and belonged to the person who reduced them to possession), forced the oil industry to abandon its policy of maximizing the rate of production and to accept the concept of maximizing recovery of the hydrocarbons contained in each reservoir.

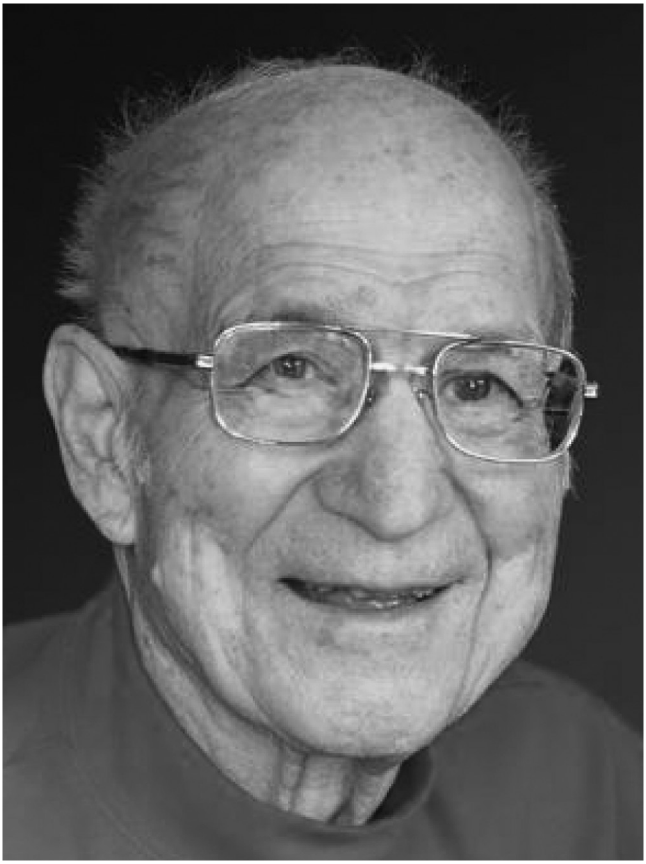
Muskat's two books contributed to the rationalization of the oil industry and still remain the most widely known books in this field of engineering. His work is probably the most cited; for example, the introduction, translated by R. de Weist, to "Theory of Groundwater Movement" by Polubarinova-Kochina said, "It is a classic, much like Morris Muskat's

Flow of Homogeneous Fluids Through Porous Media" (originally published in 1937 and translated into Russian 13 years later). Petroleum reservoir engineering is the most complex of the specialties in petroleum engineering because it must deal with mixtures of liquid and gaseous hydrocarbons that are no longer in equilibrium after production begins and are contained in a poorly defined porous medium at significant depth. Dr. Muskat helped establish the basic principles of this discipline. He defined the fundamental parameters and dynamic concepts governing the flow of oil and gas within a reservoir. His theoretical studies of steady-state and transient flow through porous media are considered classics in the field of hydrology.

Despite his role as the acknowledged founder of reservoir engineering, Morris found time to publish, and to obtain patents, in many diverse fields of science and engineering—for example, quantum mechanics, scattering of alpha-rays, well logging (microwave and neutron), mass spectroscopy, isomerization, lubrication theory, hydrodynamics, and mechanics of shaped charges.

Following the tragic death of his daughter, Rosalyn, in a road accident in Vietnam in 1969 and the death of his wife, Fern, a few years later, Morris relocated to Pasadena, California, and disengaged himself from professional activities. He told me that, although he still maintained a deep interest in U.S. oil and gas reserves, his principal concern was focused on the proliferation of nuclear weapons and the uncertainty of humanity's survival.

His older daughter, Phyllis M. Goddard, of Altadena, California passed away in January, 2004. He is survived by sons David A. Muskat of Painesville, Ohio, and Robert E. Muskat of The Woodlands, Texas, and seven grandchildren.



PHILLIP S. MYERS

1916–2006

Elected in 1973

"For contributions to the understanding of ignition and heat transfer problems of internal combustion engines and their environmental impact."

BY RODICA A. BARANESCU

PHIL MYERS was, arguably, the most influential engine combustion researcher of his generation, and he left a rich, unparalleled legacy of teaching, research, and service. He pioneered techniques for in-cylinder temperature measurements and made important contributions to understanding the diesel combustion process, droplet combustion, engine heat transfer, and engine modeling.

Phil was born in Webber, Kansas, to Earl and Sarah Catherine (Breon) Myers on May 8, 1916. After completing his B.S. in mathematics at McPherson College in 1940, Myers received a B.S. in mechanical engineering from Kansas State College in 1942. In 1942 he came to the University of Wisconsin-Madison and joined the Department of Mechanical Engineering. He earned his M.S. and Ph.D. degrees from UW-Madison in 1944 and 1947, respectively, and remained at Madison as part of the faculty, receiving tenure in 1950 and achieving the rank of professor in 1955.

He served the Department of Mechanical Engineering in a wide range of capacities, culminating in his stewardship as its chair from 1979 to 1983. He chaired and served on many College of Engineering committees. Myers also served on a number of campus-wide committees and was the chairman of the University Committee in 1974. Professor Myers was one of the rare individuals whose research excellence was balanced by his strong commitment to teaching and service. Phil's door was always open, and regardless of how busy his schedule was, he made time to answer students' questions.

Phil Myers together with Otto Uyehara founded in 1947 what is today the prestigious Engine Research Center at the UW-Madison. They embarked on an academic and personal partnership that lasted their entire careers. Together, Phil and Otto mentored 48 Ph.D. students and 80 M.S. students, many of whom went on to influential careers in the engine industry and academia.

After long and frustrating hours in the laboratory, in the library, and off campus, graduate students came to see the value of Phil's demanding attitude. His perennial stubbornness developed in students the invaluable qualities of perseverance, motivation, and perspective in difficult situations, all of which are important in succeeding in life as well as in a professional career. "The trouble begins," he believed, "when research becomes an end in itself. Research is essentially the tool that molds the graduate student into a capable engineer."

Phil sometimes used similar tactics with fellow faculty members. Indeed, as Professor Bill El-Wakil noted, "Phil's great contribution has been not only teaching students, but teaching faculty to be good faculty."

Professor Myers's teaching accomplishments were acknowledged with the Pi Tau Sigma Gold Medal Award, the Tau Beta Pi Teaching Award, and the College of Engineering's Benjamin Smith Reynolds Award. His most significant teaching impact, however, was made one on one in the laboratory with his graduate students in conjunction with Professor Uyehara. The alumni from their T-25 lab are spread around the globe, and as news of Professor Myers's passing circulated, the outpouring of well wishes was astounding.

Professor Myers retired to emeritus status in 1986 but was a constant presence in the department until shortly before his passing. He continued to serve on government and NAE study panels, including the committee that recommended the Corporate Average Fuel Economy (CAFE) standards for automobile engines. He served on Nelson Industries and Echlin industrial boards of directors and consulted widely throughout the engine industry, especially to International Harvester, Chevron, Cummins, General Motors, Texaco, and the U.S. government.

His research excellence was recognized by a long and impressive list of citations from the Society of Automotive Engineers (SAE), including the Ray Buckendale Award, and the Arch T. Colwell Award (twice). In 1977 Phil was named a fellow of the SAE, and in 1987 he was the first recipient of the SAE Medal of Honor. Phil Myers was also named a fellow of the American Society of Mechanical Engineers (ASME) in 1971 and was awarded the Dugald Clerk Award from the Institute of Mechanical Engineers (England). In 1973 Professor Myers was elected to the National Academy of Engineering (NAE).

Phil participated in SAE ever since his first contact with the society at the 1940 fuels and lubricants meeting. At that meeting he was a member of the victorious Kansas State College team, which debated that "higher compression tractor engines are to be preferred for tractor power equipment." After joining SAE in 1946, Phil served in all offices of the Milwaukee section. Nationally, he served as chairman of the power plant activity and, as a member of the Engineering Activity Board, helped start the Engineering Education Activity. He chaired the Publications Advisory Committee of the SAE Engineering Activity Board and was also a member of the SAE's Board of Directors and the Objectives Planning Committee. In 1969 Professor Myers was elected president of SAE, the first academic ever to be chosen for this prestigious position. The SAE has served as the preeminent international society of the mobility community since its inception in 1905 and currently boasts a membership of more than 100,000 professionals in 97 countries.

Through all of his success, Phil never lost touch with his rural Midwestern upbringing. He was a humble man who always made time to listen to all points of view and was guided by an unwavering moral compass and a dogged pursuit of the truth. His compassion for others was as legendary as his water skiing prowess and his fondness for churning his own ice cream. Yi Liu wrote in 2006 to his widow Jean: "I am writing you this letter because I feel that I owe Prof. Meyer a sincere 'Thanks!' Let me explain: I am a Chinese and I came to this country in 1999. I was first at another University and that time was for me like a disaster. I did everything wrong and I wanted to give up my study . . . I took a last look around to see if any miracle would happen . . . I sent an email to Prof. Meyers to ask for his advice. And shockingly, he replied sooner than everybody else. His letter was full of encouragement and he did take time to read my resume and to give me detailed instructions. His email was so warm and nice and, to be honest, when I sent such an email to this extremely outstanding professor I did not expect to hear from him at all."

Off campus, Phil's lively spirit and keen mind kept him active in community affairs. He was a member of the Board of Trustees of Shorewood Hills (the Madison suburb in which he and wife, Jean, made their home for many years). Phil and Jean were joint presidents of the local parent-teachers association. Both were active in the Methodist Church, with Phil playing a significant role in the church's Pine Lake Camp.

The Myers family was together whenever possible. So it was natural that one of their favorite hobbies was joint activity-camping. It was on one of their longer trips, to the Seattle World's Fair, that a grizzly bear bit Phil's arm while he was photographing it from the car. He carried the scars and used to joke about it quite often.

Phil's love of the outdoors did not stop there, as he was always athletically inclined. While at McPherson, he was an all-conference full-back (1938–1940). He enjoyed traveling, camping, waterskiing, and spending time at the family cottage near Westfield. He continued water skiing even after retiring and participated in a university exercise program, a scientific project to determine the effects of exercise on the health of senior adults.

Phil was a man of principle who knew what he believed, but he always listened to and considered the opinions of others with respect. Throughout his life Phil was a teacher, mentor, father, and source of strength to his family, his students, his colleagues, and his friends. Gary Borman, a longtime colleague, summed it up: "It is difficult to say anything original about a fellow who has been as successful, both in the university and outside, as Phil has. Someone ought to say that Phil is a very fair and honest person—and a good man. Perhaps, after all is said and done, that's one of the best things you can say about anyone."

For the academic and engineering communities, Phillip S. Myers was a shining example of professional excellence, outstanding integrity, and significant contributions to advancing the state of the art of internal combustion engines. I have been privileged to have known him and benefited from his exemplary leadership, first as a Romanian visiting professor at UW-Madison, then as an engineer in the American automotive industry and also as a colleague in the NAE. His national and international impact continues through the many generations of engineers he educated and mentored.

Phil and Jean's generosity led to the Phil and Jean Myers Professorship in the Department of Mechanical Engineering, two Wisconsin distinguished graduate fellowships, an endowment for the Myers Automotive Laboratory (so named by the third-party donor who established the facility for undergraduate automotive projects), and the Uyehara-Myers Scholarship Fund, all at UW-Madison; several scholarships and faculty award funds at McPherson College and Kansas State University; the Myers Award for Outstanding Student Paper published by SAE and the Myers-Uyehara Outstanding Student Paper Award published by SAE India Affiliate.

Phil is survived by Jean, his wife of 63 years; daughters Katharine Muirhead, Elizabeth Baird, and Phyllis Rathbone; twin sons John and Mark Myers; eight grandchildren; and three great-grandchildren.

The support of the Myers family is greatly acknowledged. They provided and checked biographical information and supplied the photograph taken at Phil Myers's 90th birthday celebration.

Robert E Newnham

ROBERT E. NEWNHAM

1929–2009

Elected in 1989

"For contributions to the development of composite materials for electronic applications."

BY L. ERIC CROSS AND SUSAN TROLIER-MCKINSTRY

ROBERT EVEREST NEWNHAM, Alcoa Professor Emeritus of Solid State Science at the Pennsylvania State University, passed away April 16, 2009, at the age of 80. He retired from Penn State in 1999 after serving eight years as associate director of the Materials Research Laboratory and 18 years as director of the Intercollege Program on Solid State Science. Bob is remembered with great love by friends, former students, and scientific colleagues around the globe.

He was born March 28, 1929, in Amsterdam, New York, to William E. and Dorothy M. Hamm Newnham.

On July 26, 1964, Bob married Patricia Friss Newnham, a beautiful nurse from E. Hartford, Connecticut, who survives him. Bob and Pat had two children: a son, Randall E. Newnham of Reading, Pennsylvania, and a daughter, Rosemary E. Newnham of New York City. They survive, along with Randall's wife, Janet Graden, grandson Jonathan Robert Newnham, and Rosemary's husband, Patrick Ying and grandson Henry Everest Ying, born January 2010. His sister Mary Lucy Carlson, her husband Rupert, numerous nieces and nephews, and their families also survive.

A graduate of four universities, Bob studied mathematics at Hartwick College (B.S., 1950), physics at Colorado State University (M.S., 1952), physics and mineralogy at Penn State (Ph.D., 1956), and crystallography at Cambridge University (Ph.D., 1960). Prior to joining the Penn State faculty in 1966, he was an ICI fellow at the Cavendish Laboratory of Cambridge University and taught in the Department of Electrical Engineering, Massachusetts Institute of Technology (MIT) for 10 years.

At Penn State, Bob taught courses on crystal physics, crystal chemistry, electroceramics, mineralogy, gem minerals, biomaterials, x-ray diffraction, and crystal structure analysis. Widely known for his enthusiastic lectures and colorful illustrations, Bob was honored with the Outstanding Educator Award of the Ceramic Education Council and the Wilson Teaching Prize of the College of Earth and Mineral Sciences. During his career, he delivered the Dow lectures at Northwestern University, the Wolff Lecture at MIT, the McMahon Lecture at Alfred University, the Pond lectures at Johns Hopkins, the Maddin Lecture at the University of Pennsylvania, and the Byron Short Lecture at the University of Texas. After retirement Bob taught for two years at the Hong Kong Polytechnic University and the Georgia Institute of Technology.

Professor Newnham was a master teacher. It is easy to see why when you read any of his lucid books. He had a gift for taking difficult concepts and explaining them simply without introducing error.

Professor Newnham was active in several professional societies, serving as editor of the *Journal of the American Ceramic Society*, secretary of the Materials Research Society, president of the American Crystallographic Association, and distinguished lecturer for the Institute of Electrical and Electronics Engineers (IEEE). Among his many awards was the Jeppson Medal, the E. C. Henry Award, the Bleininger Award, the David Kingery Award of the American Ceramic Society, the third Millennium Medal and Ultrasonics Achievement Award of the IEEE, the Centennial Award of the Japan Ceramics Society, the

Turnbull Lecturer Award of the Materials Research Society, the Adaptive Structures Prize of the American Society of Mechanical Engineers, the Benjamin Franklin Medal for Electrical Engineering from the Franklin Institute, and the Basic Research Award of the World Academy of Ceramics.

A member of the National Academy of Engineering, Bob Newnham wrote five books and more than 500 research papers and held 20 patents on electroceramics and composite materials for electronic and acoustic applications.

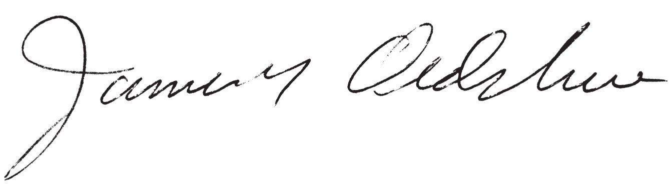
Early in his scientific career, he was a crystallographer. He loved minerals, structure property relations, and symmetry. Generations of students remember the "symmetry dance" he did to show the four principal symmetry operators. He did structure refinements of many important minerals, including the feldspars, several layer silicates, fresnoite, and the bismuth layer structure ferroelectrics. His knowledge of minerals and structure-property relations was encyclopedic. One summer he memorized the name and chemical formula of every mineral.

His work in electroceramics began in quartz piezoelectrics and continued through a long and productive professional relationship with Eric Cross. The two were great personal friends. Together, they built up one of the largest ferroelectrics research programs in the world. Bob and Eric for decades were the pivotal force in the United States in the field of ferroelectric materials. The two of them educated an entire generation of ferroelectricians. Together they explored the field of secondary and tertiary ferroics, as well as piezoelectrics, electrostrictors, capacitors, and composites.

The composite piezoelectric transducers developed in his laboratory revolutionized the quality of ultrasound images in cardiology, obstetrics, and Navy sonar. Every major ultrasonics manufacturer in the world uses composite transducers based on his designs. He was truly proud that his invention became ubiquitous in the field of biomedical ultrasound. He spoke several times of the thousands of people whose lives he had been instrumental in saving through this invention. Many of us who knew him were encouraged to go out and do something worthwhile for humanity. His miniature flextensional transducers for hydrophone-towed arrays are one of Penn State's most successful patents. They are widely used in underwater oil exploration and geophysical research.

In private life, Bob was an unabashed liberal in politics and religion. He and his wife, Pat, were strong supporters of the peace movement, the Unitarian-Universalist Fellowship of Centre County, Pennsylvania, and numerous liberal charities. In his spare time he was an ardent mineral collector and model airplane builder. He used to say he loved the smell of airplane glue.

He was a great scientist, teacher, colleague, friend, and person. His life is an inspiration to all of us.



JAMES Y. OLDSHUE

1925–2007

Elected in 1980

"Pioneering work in establishing the fluid mechanics of mixing and its practical application to industrial and municipal processing."

BY JAMES WEI

JAMES Y. OLDSHUE, an internationally recognized chemical engineer and authority on fluid-mixing technology, died on January 16, 2007, at the age of 81. He was elected to the National Academy of Engineering in 1980 for his pioneering work on the fluid mechanics and practical applications of mixing in industrial and municipal processing.

Jim Oldshue was born in Chicago on April 18, 1925. He received his B.S. in chemical engineering in 1947, M.S. in 1949, and Ph.D. in 1951, all in chemical engineering, from the Illinois Institute of Technology. Besides being an excellent student, he played on both the basketball and baseball teams and was a member of Phi Lambda Upsilon, Alpha Chi Sigma, Pi Delta Epsilon, Sigma Xi, and Tau Beta Pi. During World War II, he interrupted his education to work at the Los Alamos Laboratory for the Manhattan Project from 1944 to 1945.

Jim's most important professional contributions were in the field of fluid mixing, which is fundamental to many operations in chemical processing. For example, the quality of paint depends on the thorough mixing of the dyes and solvent; the destruction of bacteria in wastewater depends on intimate contact with chlorine; and the quality of paper depends on the uniform distribution of fibers and glue. The quality of these and many other products depends on different ingredients being uniform and in good contact with each other.

Although Jim's work was based on the scientific disciplines of fluid shear and turbulence, he excelled in designing small laboratories and pilot plants to obtain design data and analyses for scale-up to full-size plants. His work was particularly important to mineral processing, food processing, petrochemical processing, waste and water treatment, and pulp and paper processing. One of his best known inventions is the Oldshue-Rushton extraction column which can be used to transfer finely divided solids (or a chemical) from one liquid to another immiscible liquid, or from a gas to a liquid, in a baffled, mechanically agitated tank that is constructed with separate stages.

Jim wrote more than 100 articles and reports on the design and scale-up of mixing equipment and was the owner of at least 10 patents. His most influential book was *Fluid Mixing Technology* (McGraw-Hill, 1983), which was widely used. His approach was based on practical applications of technologies—the kinds of mixing equipment available, their characteristics and salient performance features, and their effectiveness in different industries. He gave numerous lectures and short courses at continuing-education meetings sponsored by the American Institute of Chemical Engineers (AIChE), as well as lectures at seminars and conferences in Europe, Australia, Asia, Africa, and Latin America on the appropriate equipment and operations for mixing in various chemical processes.

He received numerous awards for his achievements. AIChE awarded him the Founders Award, Van Antwerpen Award, and Service to Society Award. In 1986, he received the Kenneth A. Rowe Award from the American Association of Engineering Societies, and in 1991, he was honored with the Victor Marquez Award from the Inter-American Confederation of Chemical Engineering Societies.

Jim was active in a number of professional organizations. He was president (1979), treasurer (1983–1989), director (1970–1972), and unofficial foreign secretary of AIChE, as well as chair of the organization's Equipment Testing Procedures Committee and International Activities Committee. In 1983, for AIChE's Diamond Jubilee, he chaired a committee that put together a list of 30 Eminent Chemical Engineers based on their contributions to the profession and to society. In 1966, he was president of the 4th World Congress of Chemical Engineering, which was held in San Diego. In addition, he was secretary general of the Inter-American Confederation of Chemical Engineering Societies and chair of the American Association of Engineering Societies (1985).

His participation in civic societies was equally impressive. As budget chair of the International Committee of the National Board of the YMCA, he visited YMCAs around the world. Jim was a member of the First Reformed Church in Rochester, New York, and a member of the denomination's national General Program Council, he followed in the footsteps of his ancestors who emigrated from Holland in the 1600s. He was also a member of the Rochester Rotary and chair of its International Service Committee. After retirement, he continued in active participation in the Sarasota, Florida, chapters of the YMCA and the Rotary, and taught numerous continuing education classes related to science for Oasis Education Centers. He was a members of the Siesta Key Chapel in Sarasota.

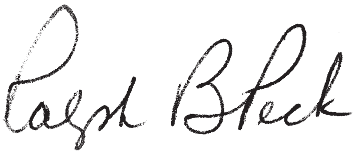
Despite his frequent travel, Jim was actively involved in his children's school activities, including particularly challenging homework assignments in mathematics and science. He was a regular fixture with his wife, Betty, at this sons' athletic, music, and other school events, even during their college years when attendance occasionally required being in Rochester, New York, Pittsburgh, Pennsylvania, and Williamstown, Massachusetts on the same weekend.

Six feet, six inches tall with a deep, resonant voice, Dr. Oldshue was a man of imposing stature who was entrusted with many leadership responsibilities in response to his eagerness to serve and his earnest integrity. Despite his earnestness, he also had a good sense of humor and was known for telling funny stories. He loved sweets and usually read the dessert section on the menu first and composed his dinner selection around his choice of dessert. He often dressed elegantly in Hong Kong-tailored jackets and suits of various colors; on consecutive days he could be seen in suits of lime green, royal blue, or salmon red.

A tireless traveler, he visited customers all over the world who requested advice on fluid-mixing equipment and operations; he used those opportunities to further his mission to establish and maintain bridges of international cooperation for the Reformed Church, for the YMCA, and for chemical engineering societies. He belonged to a Travelers Century Club that had a prerequisite for membership of having visited 100 countries (he visited more than 120). Long before the concept of globalization had much of a following, he was a natural ambassador to other countries and races.

Jim worked for 42 years at the Mixing Equipment Company of Rochester, New York, rising to the rank of vice president and director of research. Then, in 1994, he became founder and president of Oldshue Technologies International. In 2005, he moved to Sarasota, Florida, where he died a few years later after a brief illness.

He is survived by his wife of 59 years, Betty; three sons, Paul of Portland, Oregon; Richard of Glenview, Illinois; and Robert of Jamaica Plains, Massachusetts; and seven grandchildren. The Illinois Institute of Technology dedicated the Oldshue Unit Operations Laboratory in his memory on April 2008.



RALPH B. PECK

1912–2008

Elected in 1965

"Soil mechanics and foundation engineer."

BY GHOLAMREZA MESRI
SUBMITTED BY THE NAE HOME SECRETARY

RALPH B. PECK, professor emeritus of civil engineering at the University of Illinois at Urbana-Champaign and one of the most influential engineers of the twentieth century, died on February 18, 2008, at the age of 95.

He was born in Winnipeg, Manitoba, on June 23, 1912, to American parents, Orwin K and Ethel Huyck Peck, when his father was a bridge engineer with the Grand Trunk Pacific Railroad in Canada. Ralph Peck earned a degree in civil engineering in 1934 and a doctorate in civil engineering in 1937, both from Rensselaer Polytechnic Institute in Troy, New York. Ralph was employed from 1937 to 1938 as a structural detailer for American Bridge Company. In 1938–1939 he attended a course on soil mechanics at Harvard University and was a laboratory assistant to Arthur Casagrande. From 1939 to 1942, Peck was an assistant subway engineer for the city of Chicago, representing the "Father of Modern Soil Mechanics" Karl Terzaghi, who was a consultant on the Chicago subway project.

In 1942, Peck joined the University of Illinois, where he was a professor of geotechnical engineering from 1948 to 1974. After that he was a Professor Emeritus and a consultant in geotechnical engineering. Although he had moved to Albuquerque, New Mexico, he returned to the University of Illinois twice a year to deliver a series of lectures and to continue his interactions with students and faculty members until the age of 93. In 1987, the University of Illinois held a symposium in his honor, and in 1999 he was honored with an ASCE Geo-Institute Conference.

Ralph Peck, with Karl Terzaghi, published the most influential textbook in geotechnical engineering, *Soil Mechanics in Engineering Practice* (Wiley, 1948). The 3rd edition, with an additional co-author, Gholamreza Mesri, was published in 1996. With Walt Hanson and Tom Thornburn, Ralph Peck published *Foundation Engineering* (Wiley, 1953), a widely used textbook. Ralph built a premiere geotechnical program at the University of Illinois fulfilling Karl Terzaghi's hope that he would "educate a generation of geotechnical engineers who retain common sense and their sense of proportion." From 1942 to 1974, Ralph Peck directed 39 doctoral students. During those same years, more than 5,000 students attended his lectures.

Ralph taught the practical art of problem solving, always using the observational approach, and he had a profound influence on many, many students. As one distinguished engineer said, "To meet him, to listen to him, to be influenced by him at an early age have been gifts I value."

Ralph Peck's life and work have been detailed in two books and a publication of the Norwegian Geotechnical Institute (NGI). *Judgment in Geotechnical Engineering—The Professional Legacy of Ralph B. Peck* by John Dunnicliff and Don U. Deere was published by John Wiley & Sons in 1984. *Ralph B. Peck, Engineer, Educator, A Man of Judgment,* edited by Elmo DiBiagio and Kaare Flaate, was published by NGI in 2000 for the dedication of the Peck Library, which stands next to the Terzaghi Library at NGI in Oslo. The most recent and most detailed of the three, *Ralph B. Peck, Educator and Engineer, The*

Essence of the Man, by John Dunnicliff and Nancy Peck Young, was published by BiTech Publishers Ltd. in 2006.

In addition to co-authoring the two most influential textbooks mentioned above, Ralph Peck's list of technical publications includes 260 invited lectures, journal and conference articles, discussions, and reports. Some of his key lectures and publications are "Earth-Pressure Measurements in Open Cuts, Chicago (Ill.) Subway" (1943); "Deep Excavations and Tunneling in Soft Ground" (1969); "Advantages and Limitations of the Observational Method in Applied Soil Mechanics" (1969); "The Direction of Our Profession" (1973); "Influence of Nontechnical Factors on the Quality of Embankment Dams" (1973); "Pitfalls of Overconservatism in Geotechnical Engineering" (1977); "Where Has All the Judgment Gone?" (1980); "The Last Sixty Years" (1985); and "Gaining Ground" (1997).

Ralph Peck directed his energies toward bridging the gap between academia and engineering practice. He recognized that "No theory can be considered satisfactory until it has been adequately checked by actual observations." He was a consultant in the United State and 33 foreign countries on more than a thousand civil engineering projects. Major dam and tunnel projects included Portage Mountain (Bennett) Dam in British Columbia; Lower Notch Dam in Ontario; Churchill Falls Dams in Labrador; James Bay Dams in Québec; Itezhitezhi Dam in Zambia; Saluda Dam in South Carolina; Wilson Tunnel in Hawaii; the Bay Area Rapid Transit System in San Francisco; and the Washington, D.C., Baltimore, and Los Angeles Metro Systems. Ralph Peck was also a consultant on foundations of structures for numerous projects, including the World Trade Center in New York. One of his last projects was the foundations of the Rion-Antirion Bridge in Greece.

Ralph was a member of the Executive Committee of the Soil Mechanics and Foundation Division of the American Society of Civil Engineers (ASCE) from 1954 to 1957 and chairman in 1957; he was a member of the Board of Directors of ASCE from 1962 to 1965. He was president of the International Society of Soil Mechanics and Foundation Engineering from 1969 to

1973. In 1999, the Geo-Institute of ASCE established the Ralph B. Peck Lecture and Medal in his honor.

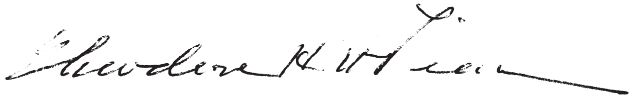
Ralph Peck was awarded an Honorary Doctor of Engineering Degree by Rensselaer Polytechnic Institute in 1974 and an honorary degree of Doctor of Science by Laval University, Québec, in 1987. He was invited to give the Ninth Rankine Lecture of the British Geotechnical Society in 1969.

Other major honors included the 1944 Norman Medal, 1965 Wellington Prize, and 1969 Karl Terzaghi Award, all from ASCE; the National Society of Professional Engineers Award in 1972; the Outstanding Civilian Service Medal of the U.S. Army in 1973; Washington Award of the Western Society of Engineers in 1976; Rickey Medal from ASCE in 1988; John Fritz Medal from The American Association of Engineering Societies (AAES) in 1988; and ASCE OPAL (Outstanding Projects and Leaders) Award for Outstanding Lifetime Achievement in Education in 2001.

Ralph B. Peck was elected a member of the National Academy of Engineering in 1965. In 1975, President Gerald R. Ford awarded him the National Medal of Science "For his development of the science and art of subsurface engineering, combining the contributions of the sciences of geology and soil mechanics with the practical art of foundation design."

No doubt Ralph Peck had remarkable technical knowledge and experience. But what distinguished him was his exceptional ability to communicate at every level and in every form and his superb judgment and wisdom. These qualities combined made Ralph Peck a kind, considerate, thoughtful, and humane man. He communicated both eloquently and humbly. In the words of one distinguished engineer, "Ralph Peck was not only a gentleman, but also a gentle man." This sentiment is shared by all of his colleagues, co-workers, and friends.

Ralph married Marjorie E. Truby on June 14, 1937; she died in 1996. They had been married for fifty-nine years and he had known Marjorie for over seventy years. He is survived by a daughter and son-in-law, Nancy Peck (Allen) Young; and son and daughter-in-law, James (Laurie) Peck; and two grandchildren, Michael Young and Maia Peck.



THEODORE H. H. PIAN

1919–2009

Elected in 1988

"For pioneering research and continued development of hybrid finite element methods for the analysis of structures."

BY PIN TONG
SUBMITTED BY THE NAE HOME SECRETARY

THEODORE HSUEH HUANG PIAN, a prominent aeronautics and astronautics professor and researcher at the Massachusetts Institute of Technology (MIT), died of natural causes on June 20, 2009, at the age of 90. The scientific and engineering world will long remember Dr. Pian's innovative and inspiring contributions to the fields of structure mechanics and finite element methods. Those of us who loved him knew him as a husband, father, brother, grandfather, uncle, colleague, mentor, and above all a friend.

His Career

Dr. Pian was born in Shanghai on January 18, 1919, and raised in Tianjin, China. After finishing Nankai Middle School, he earned a bachelor's degree in engineering in 1940 at the Tsing Hua University in Beijing.

Engineering was not Dr. Pian's first choice of study. His daughter, Canta, said: "He wanted to major in architecture, but the Chinese knew that engineering was the key to the future of China. So he took the engineering exams. He was a stellar student. Engineering wasn't his first choice, but he was obviously a very creative person, and he applied that in his engineering career."

During World War II, Dr. Pian was employed as an aerospace engineer in the interior of China (Kunming and Chengdu) before continuing his studies in the United States in 1943. He received his master's degree at MIT in 1944. After serving in the U.S. Marine Corps in 1945, he reentered MIT in 1946, where he received his D.Sc. degree in 1948. Then he spent his entire professional career at MIT. He rose from teaching assistant and research associate in the Department of Aeronautics and Astronautics to full professor in 1966 and retired in 1990. He remained active in his field long afterward.

Dr. Pian was a deep and thorough thinker and an unassuming, brilliant researcher. He focused his research on analysis of aircraft structures, including elastic-plastic creep, shear lag, stresses, and bending of plates and shells, and pioneered the development of several finite element methods. He collaborated with me in applying variational methods to elasticity, plates, shells, and computational mechanics. His 1964 seminal article published in the *AIAA Journal* broke new ground for the hybrid and mixed finite element methods. His contributions to the understanding of structural mechanics and finite element methods are legendary and prolific. By the time he retired, he had penned more than 200 professional papers and his name has graced many more. He wrote or edited several books in the field of finite element methods. Many of the analysis techniques he helped develop are in wide use today.

Dr. Pian helped push the frontiers of finite element methods and computational mechanics. He had played a role in establishing computerized methods as a universal structural analysis tool replacing rule-of-thumb designs.

During his career through five decades, Dr. Pian maintained active collaboration with national and international scholars and researchers. He lectured at 46 universities in the United States, as well as at 55 universities in other countries, including China, Japan, India, Israel, Germany, Britain, and Canada. He also served as a visiting professor at 10 foreign universities and was named an honorary professor at several engineering schools and aeronautical institutes in China.

The students who obtained degrees from MIT and the postdocs and young collaborators who trained under his guidance not only came away with a sound technical foundation but were profoundly influenced by his humility, civility, patience, and perseverance. The inspiration from Dr. Pian benefited his colleagues and friends personally and professionally and in turn expanded the world's understanding of the finite element method.

Awards

For his outstanding contributions to the aerospace sciences, Dr. Pian received many honors during his career. He received the von Karman Memorial Prize with Dr. Pin Tong for outstanding contributions to aerospace structural-material technology in 1974 and was given the Structures, Structural Dynamics, and Materials Award from the American Institute of Aeronautics and Astronautics (AIAA) in 1975. He was a member of the National Academy of Engineering and a fellow of AIAA. He was also named honorary member of the American Society of Mechanical Engineers, the highest honor bestowed by the society, and he was elected a foreign member of the Chinese Academy of Sciences.

The Man

In 1945, Dr. Pian married Rulan Chao, a Harvard graduate student he met while at MIT who is now a Harvard professor emeritus of East Asian studies and music. Her support and love contributed greatly to his achievements.

Dr. and Mrs. Pian opened their Cambridge home to many Chinese immigrants, visitors, families, and colleagues. They helped generations of Chinese students adjust to life in America. They mentored, entertained, hosted, and shared their home with students. They supported and nurtured Chinese student groups and were greatly interested and actively participated in student activities. Even after retirement, Dr. Pian continued to give Chinese graduate students advice, host memorable and lively Thanksgiving dinners, and provide students a gathering place over holidays and a regular place for an unscheduled drop by and unpretentious chat.

"He was extremely humble," said his son-in-law Michael Lent, who recently came across his father-in-law's collection of plaques and medals. "A lot of people would have built a glory wall and hung all this stuff, but he would be the last person to do that." Dr. Pian kept his tucked away in the basement.

Dr. Pian was a kind gentleman, unassuming and thoughtful. His caring and support enriched the lives and launched the careers of many—his students, postdoctoral scholars, and young associates. Their genuine affection and admiration for him were reflected in their enthusiastic participation in the 1990 symposium in tribute to him for his retirement from MIT and at his 90th birthday party in 2008 at his home in Cambridge.

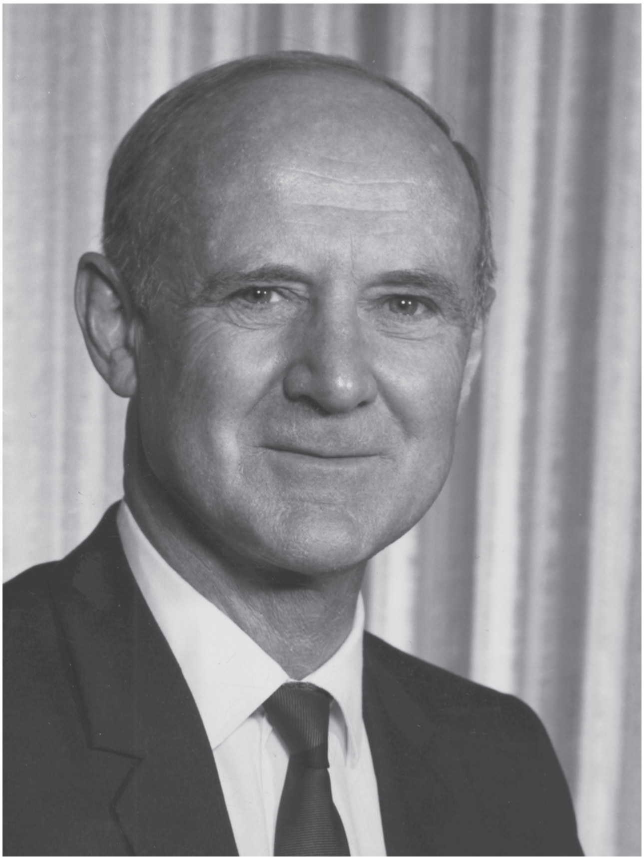
Dr. Pian is survived by his wife Iris Rulan Chao Pian, his daughter Canta of Washington, D.C., his son-in-law Michael Lent, his granddaughter Jessica, his brothers in Tianjin and Australia, numerous nephews and nieces, and a large extended family of accomplished scholars and professionals.

Good-bye

Ted Pian will be sorely missed as a colleague and a friend who always gave us encouragement and support. Though it is Pian's lifetime achievements we will remember, it is his kindness that we will miss.

We grieve his passing and weep because we loved this kind and gentle man. We see his image standing on the top of a mountain with arms around his chest, gazing into the wind that brushes his hair, pondering better ways to approximate a continuum by discreet elements, and searching the new and wonderful places beyond the horizon.

May God bless Ted Pian, and may he rest in eternal peace. We shall carry on his example.



WILLIAM HAYWARD PICKERING

1910–2004

Elected in 1964 (Founding Member)

BY JOHN R. CASANI

Lumen accipe et imperti: Accept the light (of knowledge) and pass it on.

— Motto of Wellington College, the school that ignited William Pickering's interest in science and technology

"More than any other individual, Bill Pickering was responsible for America's success in exploring the planets—an endeavor that demanded vision, courage, dedication, expertise and the ability to inspire two generations of scientists and engineers at the Jet Propulsion Laboratory."

— Thomas Everhart, President Emeritus, California Institute of Technology

WILLIAM HAYWARD PICKERING—"MR. JPL," the original "Rocket Man," America's deep space pioneer, director of the National Aeronautics and Space Administration's (NASA) Jet Propulsion Laboratory (JPL; 1954–1976), and California Institute of Technology (Caltech) professor of electrical engineering, emeritus—died on March 15, 2004. He lived a life that was nearly beyond belief, as William Pickering's love for science, mathematics, and technology launched him on a career that the young Pickering could only begin to imagine: a leading role in opening the Space Age, the guiding force behind the launch of the first U.S. satellite and the exploration of distant planets.

Pickering was born on December 24, 1910, in Wellington, New Zealand. Always a successful student, his interest in amateur radio led him to pursue a degree in engineering. In 1929, after a year at Canterbury College in Christchurch (alma mater of Ernest Rutherford), the young Pickering was persuaded by his uncle to enroll at Caltech—where he earned his bachelor of science degree in electrical engineering (1932), master of science (1933), and Ph.D. in physics (1936). While a student at Caltech, Pickering married Muriel Bower. He joined the Caltech faculty in 1936, becoming a full professor of electrical engineering in 1946. Naturalized as a U.S. citizen in February 1941, Pickering retained his dual citizenship—and his love for both his birth country and his adopted country—all of his life.

During World War II, Pickering conducted research with Robert A. Millikan on the absorption properties of cosmic rays and investigated countermeasures for Japanese balloon warfare techniques for the Army Air Corps. Because of his experience in designing telemetering devices, Pickering was invited to join JPL in 1944; in 1947 his frequency modulation telemetry system for transmitting data from rockets was adopted as the federal standard. By that time, Bill and Muriel had two children: a son, William Balfour, who, sadly, died two days before his father; and a daughter, Anne Elizabeth "Beth" (now married to Wayne Mezitt).

At JPL, Pickering headed the Corporal and Sergeant missile programs, leading JPL's extensive efforts to develop the first operational surface-to-surface guided ballistic missile for the U.S. Army. Years later, in 1965, he and Robert J. Parks were issued U.S. Patent 3,179,355 for the basic concept of a guidance and control system for the Corporal missile. In an interview in 1994, Pickering joked about the trials and tribulations of testing the early guidance systems. "For the 100th Corporal that we tested, I pushed the [launch] button—and the darn thing went east instead of north. I never pushed the button again," he recalled.

In 1954, Pickering succeeded Louis Dunn as the JPL Director. About the same time, Pickering became a member of the International Geophysical Year (IGY) committee, created by the National Academy of Sciences (NAS) to consider U.S. options for IGY participation. Pickering headed a working group on tracking and satellite orbit computation and was a member of an IGY technical panel for an Earth satellite program. In 1957—while a delegate to an NAS-hosted international conference (sponsored by Comite Speciale de l'Annee Geophysique International) for IGY rocket and satellite program planning—Pickering learned that the Soviets had successfully launched *Sputnik 1.*

Pickering and his JPL team had long been ready to modify their existing upper-stage rocket motors to put a satellite into orbit. Recognizing the value of adding science to the project, Pickering had worked with James Van Allen to include his cosmic ray instrument on the satellite. All they needed to proceed was authorization from the U.S. Army. Late in 1957, faced with public humiliation after the U.S. Navy's favored Vanguard rocket exploded on lift-off, President Dwight D. Eisenhower directed JPL and the Army Ballistic Missile Agency to place the first American satellite into orbit. So it was that *Explorer 1* was famously launched on January 31, 1958—and William Hayward Pickering was thrust into the international spotlight. In no small measure, the success was due to Pickering's remarkable ability to unite scientists and engineers in common purpose. Years later, in 1975, Pickering recalled the achievement of *Explorer 1* and its impact on the new era of space exploration. "The event was symbolic of the mixing process between engineering and science, between the world and the research laboratory. . . [I]t had mixed rocket technology with the universe, and reduced astronautics to practice at last." A charismatic and compelling speaker, he exploited his "overnight success" to foster public support for the space program.

At the Caltech memorial service for Dr. Pickering, fellow National Academy of Engineering member Eberhardt Rechtin recalled that the *Explorer I* launch—not 1963—was also the "real" birth of the Deep Space Network. Pickering, Rechtin said, understood how important the *Explorer 1* flight would be. When the Army declared a tracking system unnecessary, Pickering had Rechtin send tracking stations to British Commonwealth friends around the world—thereby creating the first international network. As Rechtin said, "It was the Nigerian station that first heard the signals from *Explorer* that told us of the existence of the Van Allen ionization belts."

The *Explorer 1* launch made for a heady time, too, for the Pickering family. "I do remember the suddenness with which he stepped into the limelight," recalls daughter Beth. "He flew home about 24 hours after *Explorer 1* was launched. Mom and I had to wait while the reporters surrounded him as he got off the airplane. That was impressive! And then the next day, he brought home a telegram from the White House inviting Mom and him, along with [Wernher] von Braun and Van Allen to a state dinner three days later. I remember the hysteria as Mom and I dashed out to the stores to find her an appropriate dress. It was all incredibly exciting. I also remember my Dad realizing that the fuss was too centered around him. He worried that those who did the actual work weren't getting enough credit; after that, he started stepping aside at the news conferences and letting others tell the story."

In December 1958, JPL was transferred to the newly created NASA; soon thereafter, NASA leaders assigned responsibility for robotic exploration of the Moon and planets to JPL. Pickering said in 1993 that "JPL argued for, and received, a charter to develop the deep space missions. As a personal aside, I was delighted to hold a contract that said in essence 'go out and explore the depths of the solar system.'"

With JPL as part of NASA, Pickering's family could more fully share in his work. "I didn't know what he was up to until NASA took on the lab," Beth said recently, "but once his work became public he was full of interesting stories about the JPL projects. The visits to Washington were sometimes stressful, but on the whole he absolutely loved his role. Growing up with him was wonderful, and we would have the most wonderful conversations about all sorts of things. He was enthusiastic about my homework when I was in school, about my projects in college, and later about my chosen role as wife and mother. He was well versed on so many topics and always had interesting anecdotes or recent articles to discuss."

The transfer of JPL to NASA was the beginning of a glorious era. In 1958, *Explorer 1'*s success had propelled Pickering and his team to international prominence. Less than 20 years later, when he retired as director of JPL, he not only had been a significant and public catalyst for U.S. spacecraft visits to the Moon, Venus, Mars, and Jupiter, but he had also been a major contributor in the preparations for what would be the twin Voyagers' grand tour of the solar system.

Throughout his career, Pickering actively participated in the work of the National Academies, beginning with his contributions to the IGY, which continued until the group was discharged in 1964. In 1962, Pickering was elected to the National Academy of Science (Engineering Section), and he was inducted as a founding member of the National Academy of Engineering in 1964. He served on many NAS and NAE committees: an NAS/National Research Council ad hoc panel on scientific potential and practicability of small planetary probes (chaired by Van Allen), the NAE Subcommittee on Information, the NAE Committee on Telecommunications (including its Panel on Urban Communications and, as co-chair of the Urban Communications Subpanel on Environment and Health), and the NAE Committee on Public Engineering Policy and its Panel on Electronics Engineering. He was a member of the NAE 1966 Autumn Meeting Program Committee on engineering education and the NAE Nominating Committee. He was the NASA representative to the NAS Committee on Vision, and he encouraged the NAE to join with NAS to administer the Resident Research Associateships, a program of short-term residencies at JPL for university faculty. He briefly served on the NAS/NAE joint Committee on Scientific and Technical Communication (SATCOM), established in 1966 at the request of the National Science Foundation. Although he was unavailable to participate as fully as he would have liked, Pickering offered JPL ad hoc support in areas of secondary information services and data assemblies.

Pickering also contributed extensively to other professional aeronautics and astronautics societies—in many cases serving as president—including Fédération Internationale d'Astronautique, an exclusive organization that awarded Pickering the 1965 Le Prix Galabert d'astronautique; the American Astronautics Society; and the American Institute of Aeronautics and Astronautics (AIAA), created in 1963 via the merger of the American Rocket Society—of which Pickering was also president—and the Institute of Aerospace Science. AIAA recognized Pickering's contributions to aerospace technology with the 1969 Louis B. Hill Award, the 1986 Aerospace Award, and, in 2004, the inauguration of the William H. Pickering lecture series. Pickering was also a member and governor of the National Space Club (founded in 1957 as the National Rocket Club), a member of the Aero Club of Washington, president of the American Rocket Society, and a member of the federal Commission on Engineering Education. Through these activities he actively promoted international collaboration, education, and the application of science and engineering to the common good.

Pickering's science and engineering contributions did not end with his retirement from JPL. After a brief return to Caltech, he accepted a two-year post as the first director of the Research Institutes, University of Petroleum and Minerals, Saudi Arabia. Interested in promoting the influence of American technology in Saudia Arabia, Pickering returned to California in 1978 and established the Pickering Research Corporation, a nonprofit company that provided research and development support to the Kingdom of Saudia Arabia; consultation on reliability, safety, and failure reporting to the nonprofit Electric Power Research Institute; and remote-sensing computer-aided image processing systems in the United States and at the Beijing Research Institute, China. In 1983, Pickering, interested in alternative fuels, formed Lignetics, Inc., to manufacture wood pellets from wood waste for use in home heating. Never losing interest in the space program, Pickering was a frequent visitor at JPL, and he was among the honored guests when the rovers *Spirit* and *Opportunity* landed on Mars in January 2004.

On the home front, Bill and Muriel, who was highly regarded in her own right, were happily married for nearly 60 years; it was a great loss not only to Bill but also to the community when she died in 1992. In 1994, Bill Pickering married a long-time family friend, Inez Chapman, a wonderful and caring woman who contributed in no small measure to his happiness in the ten years before he died.

William Hayward Pickering was extensively honored throughout his lifetime, from the 1959 U.S. Army's Distinguished Civilian Service Decoration, to the 1966 Order of Merit of the Republic of Italy, to the 1993 inaugural François-Xavier Bagnoud Aerospace Prize for his contribution to space science, and the 2004 unveiling of the Rutherford–Pickering memorial in Havelock, New Zealand. He was recognized extensively by the engineering community with, for example, the 1962 George Washington Medal for Engineering Achievement, the American Society of Mechanical Engineers 1965 Spirit of St. Louis Medal, the U.S. Space Club 1965 Robert H. Goddard Memorial Trophy, and the prestigious British Interplanetary Society's special memento in 1969 to honor his work on *Mariners 6* and *7*. He was also honored by scientific societies (through such recognitions as the Scientific Research Society of America 1965 Proctor Prize and the American Philosophical Society 1966 Magellanic Premium), academia (which conferred several honorary doctorates in the United States and New Zealand), and charitable and civic organizations (such as the Los Angeles Philanthropic Association's 1969 Outstanding American award). Pickering was especially pleased to be one of the few nonpoliticians featured twice on the cover of *Time*, in recognition of the *Mariner* missions to Venus (1963) and to Mars (1965). Many of his honors created wonderful memories for his wife and children, such as their car ride together down Colorado Boulevard when Pickering was honored as the grand marshal of the 1963 Tournament of Roses Parade.

Pickering was also honored by leaders worldwide. In 1965, President Lyndon Johnson presented him with the NASA Distinguished Service Medal, and the Institution of Professional Engineers New Zealand bestowed an Honorary Fellowship.

Also in Pickering's honor, IPENZ established a series of free public lectures—the Pickering Lectures—with topics selected to interest a broad range of people, including high school students. In 1976, President Gerald Ford presented him with the National Medal of Science, the nation's highest honor for engineering excellence—possibly Pickering's most highly treasured recognition. Daughter Beth, recalls the ceremony "when Wayne, our children, and I were driven right to the White House door to attend the presentation." Also in 1976, Her Majesty Queen Elizabeth II of England invested Pickering as Honorary Knight Commander of the Civil Division of the Most Excellent Order of the British Empire in recognition of his services to science; in 2003, the government of New Zealand conferred its highest national honor, the Order of New Zealand, on Sir William. Emperor Akihito presented Pickering with the prestigious 1994 Japan Prize for Aerospace Technologies.

As far-reaching as the honors were, however, *The New York Times* correctly observed, "None of these honors . . . can add any luster to the stature he has acquired in 'nearly accomplishing the impossible.'" Nor can they add luster to the esteem, reverence, respect, and warmth with which Pickering to this day is held by his colleagues. It is no small part of Pickering's legacy that he worked tirelessly to create a work environment that would attract and retain the best scientists and engineers. An article summarizing Pickering's career through *Mariner 4* ("The Quiet Coach of the Pasadena Professionals," *Challenge,* a publication of General Electric Co., circa Fall 1965) celebrates him as a man of great composure:

> Keenly alert to all aspects of his complicated technical life, yet seemingly unshaken by frustration, or setbacks, Dr. Pickering maintains a calm that is an inspiration to those who work for him. He's the man you want to direct traffic in a tornado. You'd like him to bat with two out in the ninth and the winning run on second. "This man probably violates every managerial concept of the image of a tough, driving boss," says one associate. "He's

> gentle, thoughtful, persuasive and convincing. He gets tough jobs done and creates a positive spirit doing it."

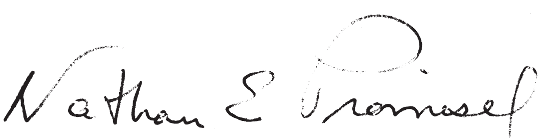
What is William Pickering's legacy, his greatest achievement? The answers to that question may be as numerous as his many honors. For example, Pickering not only put in place the organization that quickly launched *Explorer 1* but also had the foresight to include a science instrument on the satellite: Van Allen's Geiger counter, which returned the first major scientific discovery of the space race—that the Earth is surrounded by intense bands of radiation. Many consider it to be Pickering's greatest achievement that he created the opportunity to discover the Van Allen belts, thus setting the stage for future space exploration. However, in July 1969, after an American had walked on the Moon, Pickering said that his major achievement was not *Explorer 1* but rather the first lunar surface pictures returned by the *Ranger 7* spacecraft in 1966. The images showed that the Moon was not, as commonly thought, covered in a thick layer of dust; those images thereby cleared the way for Neil Armstrong's first steps on the lunar surface.

Others consider his most memorable contribution to be his advocacy for strengthening science and math education in U.S. schools. This topic not only informed his NAS, NAE, and other professional activities but was also a familiar theme in his many invited speeches. He made the most of every opportunity to promote educational and technical excellence—rather than weapons—as the way out of the Cold War.

Or perhaps his greatest legacy is his ability to inspire others to work together. Pickering's relationship with the political administration was often strained, and he daily faced the demanding expectations of the American military and the public pressure to "beat" the Soviet Union. Nevertheless, he successfully guided a diverse team of scientists and engineers; and he exploited every opportunity to encourage the engineering, scientific, political, civil, and social communities to unite in common purpose. Consequently, after *Mariner 4* arrived at Mars on July 14, 1965, *The New York Times* suggested that, because of his calls for a truly unified national space program, ". . . it is possible that Dr. Pickering's greatest contribution has been to inject constructive guidance into both governmental and public thinking about the space effort."

His daughter agrees. "My father had a deep-seated curiosity for the science, brilliance for the engineering, and a quick and open mind to understand the ideas and problems. But his great contribution after JPL was transferred to NASA was his ability to understand the work being done and to understand the culture in which the work would flourish, all while taking the administrative reins, protecting the culture, and being the political face of the lab. His patience, tact, diplomacy, respect for others around him, ability to teach, calm demeanor, and sense of purpose enabled him to generate enthusiasm for the possibilities among the politicians and to get the lab the funding it needed."

Pickering biographer Douglas J. Mudgway, describing the Caltech memorial service, further reveals Pickering's personal legacy. "[All] praised his gentleness, avid determination to succeed, his concern for humanity, and, above all, they praised him for his integrity and adherence to the fundamental principles of scientific inquiry. 'In his personal life as in his professional life in the world of space science and technology,' they said, 'William Pickering had set standards of excellence that would be an example for all that would surely follow.'" True to the education that had inspired him, William Hayward Pickering had accepted the light of knowledge and passed it on—and so it is that he continues to inspire the world to reach for the stars.



NATHAN E. PROMISEL

1908–2005

Elected in 1978

"For national and international leadership in materials development for aircraft and for national materials policy."

BY BHAKTA RATH

NATHAN E. PROMISEL, a retired metallurgical engineer who was chief materials engineer of the Naval Air Systems Command for 25 years, died on December 15, 2005, at the age of 97. He was known to his colleagues as "Mr. Materials Science" and is credited for helping make the Command's materials laboratory one of the leading research facilities in the nation. Nate was elected to the National Academy of Engineering in 1978.

He was born June 20, 1908, in Malden, Massachusetts. He skipped three years of elementary school. He received bachelor's and master's degrees from the Massachusetts Institute of Technology, the latter in 1930.

Concerned about future job prospects, and faced with a nice offer, he left MIT upon receipt of his master's degree in 1930 and went to work for the International Silver Company in Meriden, Connecticut, where he was assistant director of the laboratory. He was with the company from 1930 to 1940 and, at the same time, continued his studies at Yale University, where he also earned B.S. and M.S. degrees.

In 1931 he married Evelyn Sarah Davidoff, a registered nurse, to whom he was happily married for more than 50 years, until Evelyn died in 1995. At the time of his own death , Nate had a son, two daughters-in-law, five grandchildren, and 10 great-grandchildren; another son had died in 1998.

From 1940 to 1966, Nate was chief materials scientist and engineer for the Navy Department in Washington, D.C. From 1955 to 1964 he was the recipient of outstanding accomplishment awards from the Navy Department. From 1959 to 1971 he was member and chairman of the NATO (AGARD) Structures and Materials Panel. In 1962–1963 he was science attaché at the U.S. Embassy in London.

He was a member of the Society of Automotive Engineers, and from 1959 to 1974 he was chairman of its aerospace materials division He was a member of the American Society for Testing and Materials and was its honorary annual distinguished lecturer in 1964. He was also a member of the Alpha Sigma Mu honorary society.

From 1967 to 1970 he was U.S. representative to the Materials Research Advisory Group at the Organization for Economic Cooperation and Development. In 1970 he was named annual honorary lecturer of the Electrochemistry Society. He was a fellow of the British Metals Society, the Society for Advanced Materials and Process Engineering, the British Institution of Metallurgists, and the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME). The AIME also honored him by selecting him as an honorary member and an annual honorary lecturer.

He served as advisor to the Oak Ridge National Laboratory, Lehigh University, the University of Pennsylvania, U.S. Navy laboratories and the U.S. Congress Office of Technology Assessment.

Over the course of his 25 years at the Navy Department, Nate was responsible for a number of bold, far-reaching projects. Under his leadership and supervision, the Navy initiated the refractory sheet metal program, a titanium structural program, development of high-temperature alloys for gas turbines, and the development of carbon fibers, among other programs. Nate was often referred to as the "father of titanium" for his pioneering work to recognize the potential of titanium and to push its development aggressively. Similarly, he provided the stimulus for new lubricants and nonflammable hydraulic fluids.

In 1966, Promisel left the U.S. Navy to become executive director of what is now the National Materials Advisory Board (NMAB) of the National Academy of Sciences and the National Academy of Engineering. While he was there, the board expanded its work from government defense studies to work for all government agencies, as well as for private industry, academia, and professional societies.

Realizing the importance of bringing together many materials societies in order that the societies could speak with one voice in the halls of power, Nate conceived and became the co-founder of the Federation of Materials Societies (FMS). He was the federation's first president (1972–1973), its executive secretary for a few years following his retirement from the NMAB, and the first recipient of the federation's Decennial Award.

Promisel was named president of what is now the American Society for Materials International in 1971. He was lauded as someone who had great respect in the field and ability to organize and persuade. He recognized the potential uses of titanium as an important structural material for aerospace use earlier than most and stimulated the development of lubricants and nonflammable hydraulic fluids. Over the years the society honored him by naming him a fellow, an honorary member, Carnegie lecturer (1959), Burgess Award recipient (1961), and annual honorary lecturer (1984).

From 1973 to 1977, Nate chaired the U.S. Materials Group, which was part of the U.S./ USSR Science Exchange Program. He was the honorary guest of the USSR Academy of Sciences. He was the permanent honorary president of the International Conference on Materials Behavior and director of the Value Engineering Company.

He was named National Capitol Engineer of 1974 by the Council of Engineering and Architectural Societies. In the announcement accompanying the award, the society said:

> Mr. Promisel is recognized in the materials field as being the one engineer during the past 30 years most closely associated with the development of numerous

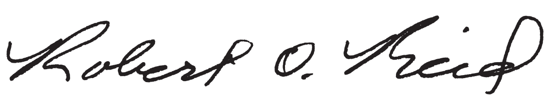
> high strength light alloys and sophisticated high strength refractory alloys, now widely employed in advanced aircraft and space systems, including their required fabrication techniques. . . . No other person in recent history more worthily deserves the title "Mr. Materials Science."

He pioneered the development of tungsten and molybdenum alloys for many applications, including their use in rocket nozzles.

After retiring from the NMAB, Nate consulted extensively. He received an honorary doctorate in engineering from the Michigan Technological University in 1978. In 1994 he received the National Materials Advancement Award from the FMS.

He published more than 40 papers, co-authored or edited five books, including *Advances in Materials Research* (1963); *Science and Technology of Refractory Metals* (1964); and *Science, Technology and Application of Titanium;* (1970). He lectured extensively. He was credited with advancing the practice of electroplating, which uses electric current to apply a thin, even coat of metal on an object.

Beginning in 2001, Mr. Promisel began what he called an "informal conversation" with his grandson, Brett. He said it was "by no means an autobiography" but "a somewhat random accumulation of snapshots and vignettes fueled by a wistful odyssey down memory lane." It was dedicated to "those generations of the Promisel clan who have the curiosity to glance back." The conversation, transcribed by Brett, was a wonderful bonding experience and yielded a fascinating memoir. It displays the qualities that Mr. Promisel passed on to his next generations and for which he was widely respected: integrity, aggressiveness in the pursuit of what one believes in, devotion to family, and curiosity about the world.



ROBERT O. REID

1921–2009

Elected in 1985

"For pioneering contributions to hydrodynamical theory/applications, wave force analysis, storm tide prediction, tsunami flooding estimation, and for superlative teaching."

BY ROBERT G. DEAN

ROBERT OSBORNE REID was born on August 24, 1921, in Milford, Connecticut, and died on January 23, 2009, in College Station, Texas. He was elected to the National Academy of Engineering in 1985. He received his B.E. in mechanical engineering from the University of Southern California (1946) and his M.S. degree in oceanography from the Scripps Institute of Oceanography (1948).

He served as a weather officer in the Army Air Corps (1942–1945) and participated in meteorological and oceanographic predictions for the landings in Normandy, France, in the Second World War. Shortly after the landings, he was stationed onshore and continued to contribute to the forecasts. He later served in the Pacific theater. His academic career was spent entirely at Texas A&M University, where he progressed from assistant professor (1951) to distinguished professor (1987) when he retired. Although his contributions to physical oceanography and meteorology were very substantial, including serving as founding editor of the *Journal of Physical Oceanography* for 11 years, this memoriam will focus primarily on his engineering achievements in practice and education.

Bob was fascinated by physical ocean-related problems and applied his unusual abilities to absorb mathematical principles rapidly. His physical intuition enabled him to rapidly understand the dominant physical forces in a problem, cast them into their most relevant forms, and progress to their solutions. His publications and teaching were characterized by insight, clarity, elegance, and significant advancements. His engineering contributions were carried out with his students and spanned broad areas of the nearshore region; a few representative applications are discussed below.

His early professional career at Texas A&M University occurred at the time of the rapid development of offshore petroleum resources in the Gulf of Mexico and concerns related to wave forces and hurricane storm surges. At that time little was known regarding many of the design challenges as the exploration and development programs progressed from shallow to deep water. His contributions ranged from geotechnical considerations in offshore pipeline design to hydrodynamic loading on offshore platforms during extreme weather conditions. Along with Charles Bretschneider, Bob rapidly advanced the available knowledge related to offshore platform design, including the stability limit for breaking waves in water depths ranging from shallow to deep water, damping of waves as they propagate over various bottom sediment types, and the development and application of methods to transform measurements of irregular water surface profiles to wave velocities and accelerations, the latter being required to compute realistic wave forces.

Bob's strong analytical skills coupled with his grasp of numerical techniques enabled him to address effectively many problems of engineering interest by advantageously applying the emerging capabilities of computers. These included the wave and storm surge characteristics in Lake Okeechobee, where he and his students analyzed and interpreted data collected by the U.S. Army Corps of Engineers. He developed empirical relationships for the ratio of crest height to wave height, which proved to be in very good agreement with robust nonlinear wave theories developed subsequently.

Additionally, he constructed numerical models of the "canopy effect" that quantifies the reduction in wind stress applied to a water surface due to vegetation extending into the atmosphere.

Along with his then-student Kinjiro Kajiura, Bob was the first to solve the coupled problem of water wave damping by permeable sediments, removing the need for an ad hoc coupling of the separate problem solutions. He contributed to early understanding of the forces induced by waves on offshore structures. Prior to the capabilities to measure water particle velocities under waves and computer capabilities to apply spectral techniques, he applied a technique to objectively design numerical filters, which when convolved with the water surface, yielded the time histories of the water particle velocities and accelerations at any selected elevation within the water column.

Bob addressed many aspects of hurricanes and their effect on nearshore flooding, including the first numerical modeling of hurricane surges penetrating into Galveston Bay. Some of his seminal contributions were only published in research reports and not in refereed journals. To the best of my knowledge, along with a Ph.D. student, John Wanstrath, he developed the first curvilinear coordinate long-wave model, which allowed a much superior fit to the physical boundaries. Along with another student, he developed a numerical model of the entire Gulf of Mexico and portions of the Caribbean to investigate a peculiar phenomenon termed the "forerunner" in which a surge appears at the shoreline well before the winds. Forerunners can cause unpredicted early flooding of and prevent evacuation from low-lying areas. Due to recent measurements of an unusually large forerunner in Hurricane Ike in 2008, there has been a resurgence in interest in the cause(s) of this phenomenon, which is not predicted adequately by modern computer models. Bob showed that a significant component of the forerunner was due to a net increase in water volume in the Gulf of Mexico due to additional water driven through the Yucatan Straits and/or less water flowing out through the Florida Straits.

In other areas some of the early steady-state models predicted hurricane surges considerably lower than those measured at shore. Through graphical application of the method of characteristics, he showed that the amplification was due to a resonance resulting from the hurricane translation speed nearly matching the average speed of a long free wave across the shelf. This application included both linear and nonlinear effects.

Bob was interested in tsunamis and the risks imposed on nearshore areas. He developed and applied the first orthogonal coordinate system, which allowed a conformal mapping approach to the tsunami amplification on an irregularly shaped island. It was found that large observed inundations were primarily controlled by the geometry of the island and adjacent bathymetry and were relatively insensitive to the tsunami approach direction.

His capabilities to advance understanding on engineering problems led a number of companies and agencies to seek his assistance in better understanding these new challenges. He served as a member of the Coastal Engineering Research Board of the U.S. Army Corps of Engineers. This board, comprising three civilians and four high-ranking military, is responsible for guidance and assessment of the Corps research program in coastal engineering. He also served on committees of the National Research Council, especially those related to hurricanes and storm surge prediction capabilities.

Bob mentored many graduate students in physical oceanography and ocean engineering, at both the master's and the Ph.D. levels, whose later professional careers were enhanced by the examples he set by his curiosity and application of physical principles and mathematical techniques. Indeed, many of us who were fortunate to have benefited by his example of enthusiasm for problems in nature, his approach of representing problems in their most basic form, and the satisfaction of a meaningful solution are forever indebted to him.

A surprise celebration of Bob's 60th birthday in 1983 was organized at Texas A&M University at which many of his former students presented papers illustrating their recent work. Bob was very proud of his students and at that time had mentored 55 Ph.D. students. While working with Bob several years later, I commented on this large number. His reply was: "I have supervised an additional number of Ph.D. students since then." As a student of Bob's while studying at Texas A&M for my master's degree in the 1950s, I sometimes felt a bit embarrassed that none of us could ask an intelligent question after one of his thorough lectures. His engineering legacy includes extremely significant contributions to our understanding and design capabilities in the nearshore and a cadre of former students whose lives have been enriched by their association with such an inspiring and productive mentor.

His widow, Marjorie Ferry Reid wrote that she and Bob were married for 62 years and were the parents of 6 children; sons Robert, Russell and Thomas and daughters Nancy and Carol. Their youngest daughter, Maryellen was killed in a tragic accident in 2000. Rob and Russell are architects, and Tom has retired from A.O.L. Nancy is a veterinary assistant and Carol is an artist. Marjorie and Bob were blessed with eight grandchildren and four great grandchildren.

ALLEN F. RHODES

1924–2007

Elected in 1985

"For contributions to petroleum production technology and to the growth of the engineering profession."

BY FAZLE HUSSAIN

ALLEN FRANKLIN RHODES was born in Estherville, Iowa, on October 3, 1924, son of the late Esther Butler Rhodes and Edwin James Rhodes. He was a lifelong resident of Houston, except for 10 winters north during the height of his business career.

A graduate of Lamar High School, he held a B.S.M.E. from Rice and Villanova universities and an M.B.A. from the University of Houston. From 1943 to 1946, Allen Rhodes was a lieutenant in the U.S. Navy, serving as a torpedo bomber pilot aboard the aircraft carrier *CVE Vella Gulf* in the North Pacific.

He began his career in 1947 with Hughes Tool Company as assistant to the director of engineering. He later joined McEvoy Company, where he served as director of engineering, vice president of engineering and manufacturing, and president at the time of its merger with Rockwell Manufacturing Company in 1963. Joining Rockwell as general manager of the Houston plant, he moved to Pittsburgh, Pennsylvania, in 1964 to assume the position of vice president of research and engineering. There he organized Rockwell's first central research laboratory.

In 1971 he became vice president of corporate planning and development for ACF Industries, Inc., in New York City. After three years he returned to Houston to accept the position of president and chief executive officer of McEvoy Oilfield Equipment Company, a newly formed division of Rockwell International.

After retiring in 1979, he joined Warren Oilfield Services Company as president and executive vice president of Goldrus Marine Drilling Company, both divisions of the Warren-King Companies. During 1983–1986, he was recruited to carry out a Chapter 11 reorganization for Anglo Energy (now Nabors Drilling) in New York, followed by serving as president and chief executive officer of Gripper, Inc., and later as chief financial officer of Hydrotech Systems. He joined Silver Fox Advisors, after retiring a second time, as a mentor to small businesses and entrepreneurs and later served as adjunct professor of mechanical engineering at the University of Houston.

He was a trustee of Southwest Research Institute and a member of the board of the Houston Humane Society, as well as a former member of the board of directors of Triten Corporation, Keystone International, Rawson-Koenig, Inc., Dime Box Historical Society, and the George Lehmann Animal Shelter.

Allen Rhodes held 22 U.S. patents in oil and gas production equipment and was the author of numerous major technical publications. He was best known nationally for his service to the American Society of Mechanical Engineers (ASME) as its 89th president, the youngest person to hold this office at the time of his election. He also served as vice president of its Policy Board, Industry Department, and Standing Committee on Transportation and as chairman of the Petroleum Division and the South Texas Section. He was an appointed public member and chairman of the U.S. Department of Transportation's Gas Pipeline Safety Standards Committee in Washington, D.C., and served as chairman of the ASME Committee on Safety and Pollution Prevention Equipment used in offshore oil and gas operations. He was a past chairman of the Committee on Finance, a member of the B16 Committee on Standardization of Valves, chairman of the ASME Foundation, and an honorary member of ASME International.

Allen Rhodes was a fellow of the Institution of Mechanical Engineers (Great Britain) and a member of the Society of Petroleum Engineers of AIME, American Management Association, National Academy of Engineers, and Tau Beta Pi, the national engineering honor society. He served as vice president and director of the American National Standards Institute, director and president of the Engineers' Council of Houston, and president of the Houston Engineering and Scientific Society.

He received the Robert Henry Thurston Award from ASME, the Howard Coonley Medal from the American National Standards Institute, and the Richards Memorial Award from Pi Tau Sigma and the American National Standards Institute. He was presented the first OilDrop Award, which now carries the name of the Rhodes OilDrop Award, which is given annually for outstanding service to the Petroleum Division of ASME. He was also awarded the Distinguished Engineering Alumni Award by Villanova University.

Allen was an avid sailor, participating for many years in the Southern Ocean Racing Circuit. He won his first medal in sailing competition at age 9. His lifelong interest in sailing was attested to by an extensive collection of books on the subject.

He was a member of Chapelwood United Methodist Church, River Oaks Country Club, Rotary International, The Breakfast Association, Nomads, The Lamar 41ers, and Sons of the American Revolution.

Allen Rhodes was highly regarded by all of his professional associates and friends as a man of integrity, honesty, and fairness. A man for all seasons, he was as at home at the White House as he was working cattle at his beloved Rancho Nueces in Dime Box, Texas.

Carol Rhodes, Allen's widow, wrote, "Allen's life consisted of his work and his family, but not necessarily in that order. He put his work ahead of everything else when it needed to be, but his family **never** felt they had come in second. He was very aware that his work provided him with intellectual and financial security but that this family provided him with emotional security and love—which in the end is the most important of all."

Allen married his wife, Carol J. (Haisler) Rhodes, in 1962. His relatives include sons Stephen Haisler Rhodes and wife Yvonne of Houston and James Fleming Rhodes and wife Sheryl of Austin; adopted daughter Pury Vergara Reyes and husband Santos Jr. of Houston; granddaughter Susan Sheryl Rhodes of Austin; grandson Robert Allen Rhodes of Austin; and grandsons Ernesto David Reyes and Alex Antonio Reyes of Houston. His brother is Edwin James Rhodes and his wife, Dr. E. C. Henley of Athens, Georgia; sister-in-law Kathy Haisler Radde and husband Kenneth of Meridan, Texas; nephews Karl Radde and wife Melissa of North Zulch, Texas, and Clayton Rhodes and wife Annie of Mansfield, Ohio; nieces Elizabeth (Rhodes) Eck and husband David of Marietta, Georgia, and Anna Radde of Meridian, Texas; and cousins Ida Jo (Butler) Moran and husband Tom of Brenham, Texas, Maxine (Butler) Cochran and husband Donald of Houston, and Anne (Butler) Leonard of Roaring Gap, North Carolina.

Jacob T. Schwartz

JACOB T. SCHWARTZ

1930–2009

Elected in 2000

"For contributions to the theory and practice of programming language design, compiler technology, and parallel computation."

BY BUD MISHRA
SUBMITTED BY THE NAE HOME SECRETARY

JACOB T. SCHWARTZ, a mathematician and computer scientist from New York University's (NYU) Courant Institute and a polymath with pioneering and seminal contributions to a wide spectrum of subjects ranging from pure mathematics to applied engineering, died on March 2, 2009, at the age of 79.

Jack founded NYU's Department of Computer Science, chairing it from 1964 to 1980 and headed DARPA's (Defense Advanced Research Projects Agency) IPTO (Information Processing and Techniques Office) program from 1987 to 1989. He was the designer of the SETL programming language; the NYU Ultracomputer; the NYU Four-Finger Manipulator robot; a novel multimedia visualizer, the Fractal Computer User Centerface; and COMBAT, a whole genome sequence comparison tool.

Jack's research interests were wide ranging: the theory of linear operators, von Neumann algebras, quantum field theory, theory of money, time sharing, parallel computing, programming language design and implementation, motion planning for robots, dexterous manipulation and grasping with robot hands, set-theoretic approaches in computational logic, proof and program verification systems, multimedia authoring tools, experimental studies of visual perception, multimedia, and algorithms for analysis and visualization of genomic DNA sequences. He authored 18 books and more than 100 papers and technical reports. His students included Jerry Hobbs, Ken Kennedy, Robert Kupperman, Stanley Osher, Gian-Carlo Rota, Shmuel Winograd, Clyde Kruskal, and Larry Rudolph. His collaborators included Nelson Dunford (advisor), Martin Davis, John Cocke, Frances Allen, Ralph Grishman, Robert Dewar, Edmond Schoenberg, Alan Gottlieb, W. Daniel Hillis, Micha Sharir, Bud Mishra, Domenico Cantone, Alfredo Ferro, Eugenio Omodeo, Kenneth Perlin, and Michael Wigler.

Jack was elected to the National Academy of Engineering in 2000 for contributions to the theory and practice of programming language design, compiler technology, and parallel computation. Since his election, he made active contributions to various additional subfields of engineering: robotics with connections to mechanical engineering; multimedia and visualization technologies; and genomics, bioinformatics, and biotechnology. Jack was elected to the National Academy of Sciences in 1976. His honors included Sloane Fellow, Wilbur Cross Medal (Yale University), Townsend Harris Medal (City University of New York), Steele Prize (American Mathematical Society), and Mayor's Medal for Contributions to Science and Technology (New York City).

Jack was born to a working-class, immigrant family in the Bronx, New York, on January 9, 1930. He received his bachelor of science degree in 1949 from the City College of New York and his master's degree in 1949 and Ph.D. degree in 1951 from Yale University. He began his career as a mathematics instructor at Yale and in 1953 was promoted to assistant professor. In 1957, Schwartz joined the faculty at NYU as an associate professor and in 1958 was promoted to the position of full professor. He retired in 2005 but remained a professor emeritus of computer science at the Courant Institute, until his death. He also served as chairman of the Computer Science Board of the National Research Council and was chairman of the National Science Foundation Advisory Committee for Information, Robotics, and Intelligent Systems.

In 1958, as a mathematics graduate student at Yale, Jack collaborated with his Ph.D. advisor Nelson Dunford to co-author a three-volume treatise, *Linear Operators*, which has since become the standard text in the field and has remained continuously in print. Soon after publication of the book, in 1960s, Jack turned his attention to the field of computer science, which was still in its embryonic state, without a well-formed foundational theory or a well-tested engineering basis. By connecting the goals of computer science (in being able to perform computations with both efficiency in time and space use as well as in achieving accuracy rigorously) to pure and applied mathematics, Jack began a novel and unique style of problem solving in computer science: He showed how the design of programming language can be connected to set theory, program verification and compiler optimization to theorem proving, design of data motion in a parallel computer to group theory, robot motion planning to algebraic geometry, and dexterous manipulation to convexity theory.

For instance, when Jack became interested in the field of parallel computation in the 1960s, he started by focusing on the design of scalable shared-memory architecture and converged on an elegant mathematical solution by the late 1970s. In 1980 he wrote the influential paper, "Ultracomputers," published in October of that year in the ACM Transactions on Programming Languages and Systems. His solution was based on the notion of an ideal shared-memory parallel computer, which was based on a shuffle-exchange network and could be implemented to a good approximation in an architecture he dubbed Ultracomputer. Many of the fundamental building blocks of this architecture, most notably the use of "fetch and add" operation as a scalable synchronization primitive, have become ubiquitous in almost all parallel computing systems.

He created the NYU Ultracomputer project to implement this parallel architecture and actively encouraged industry to collaborate on research on parallel computation. For instance, in the early 1980s he collaborated with IBM to initiate the IBM RP3 project, which led to a 64-node prototype that was used for research in parallel OS, parallelizing compilers, and parallel applications; as director of DARPA/IPTO, he influenced the research agenda on parallel computing; and he became a consultant for the Thinking Machines Corporation, an early maker of massively parallel thinking machines.

Another beautiful example of this style of research occurs in Jack's work on robot motion planning, which appeared in a series of papers, all entitled "On the Piano Mover's Problem" and all co-authored with his computational geometer colleague Micha Sharir. There the problem they tackle concerns a robot that wishes to move from a source configuration (say, consisting of a position and an orientation) to a destination configuration but must move through a space cluttered with obstacles while avoiding them. The simplest version of the problem is in a three-dimensional space, where the robot and the obstacles are all polyhedral (geometric solids with straight edges and flat faces); this is the same problem that a "piano mover" faces when removing a polyhedral piano from a rectoidal New York apartment, furnished disorderedly with polyhedral furniture. The basic idea is to simply consider all possible configurations of the robots (say, all possible ordered pairs of positions and orientations) in a configuration space (a six-dimensional space of positions and orientations), which can then be divided into admissible (those configurations not obstructed by any obstacles) and inadmissible (those configurations obstructed by some obstacles) components. Because of the algebraic nature of the configurations, there are only finitely many admissible and inadmissible components, and their boundary is described by algebraic equalities and inequalities (the so-called semialgebraic sets).

All these ideas can be expressed mathematically as sentences in Tarski algebra and then verified algorithmically. In particular, the sentence that asks whether there is a semialgebraic connected component containing both the source and destination configurations also answers the piano mover's problem. This elegant solution not only energized the research in robot motion planning but also rekindled an interest in "algorithmic algebra," which has since found many other applications of similar nature: geometric theorem proving, computer-aided design, model checking in systems biology, and so forth. Jack seemed to have returned over and over to the core essence of mathematics to look for simple and elegant solutions to a diverse set of applications.

In an essay on computer science, Jack pithily described what he considered to be this essence of mathematics. “To find the simple in the complex, the finite in the infinite,” Jack wrote, “that is not a bad description of the aim and essence of mathematics.” To find the simple in the complex is not a bad description of what Jack’s work continues to represent to his friends, colleagues, mentees, advisees, and students.

Jack’s personal interests were wide and varied and included etymology, world music, music composition using software, middle school mathematics curriculum development, 3-D vision, Paleolithic stone implements, visual illusions, knots, extensive reading and cooking. In his final year Jack became interested in the basics of geometric lens optics and delved into the subject deeply enough to have started a paper on the topic. Up until one month prior to his death he was still working on transfer methods using wood, marble and clay.

Besides his wife, Diana, survivors include his daughters, Abby Schwartz of Manhattan and Rachel Fainman of Winnipeg, Manitoba; two grandchildren, Adam and Adrienne Fainman of Winnipeg, Manitoba; and a sister, Judith Dunford, the widow of the literary critic Alfred Kazin.

WILLIAM REES SEARS

1913–2002

Elected in 1968

"For contributions to research and practice of aerodynamical engineering."

BY GEORGE SUTTON

WILLIAM R. SEARS, one of the leading aerodynamicists and educators of the 20th century, died on October 12, 2002, at the age of 89.

Bill received his undergraduate degree from the University of Minnesota in 1934, then studied under Dr. Theodore von Kármán at Caltech, where he received his doctorate in 1938. His forte was analysis of aerodynamic flow, long before computer simulations were developed.

Bill was a warm, kind, interested person who helped and mentored many people. While at Caltech, he married Mabel Rhodes, Dr. von Kármán's secretary, and wrote his thesis on unsteady flow around airfoils. During World War II, he became the chief of aerodynamics and flight testing at Northrop Aircraft, Inc. Later, he headed the team that designed the first flying-wing aircraft (many of today's military aircraft are essentially flying wings) and the P-61 (the famous *Black Widow*). Near the end of the war, Bill visited and debriefed German engineers and scientists.

Bill Sears then chose to return to academic life. In 1946, he became the first director of the Graduate School of Aeronautical Engineering at Cornell University. In addition to working on unsteady aerodynamic flows with his students, he contributed to the development of one of the first high-temperature shock tubes, which made it possible to measure the electrical conductivity of ionized gases and later simulated hypersonic heating. He was also the editor-in-chief of the *Journal of Aeronautical Sciences.* I am personally indebted to him for swiftly accepting my papers on ablation heat protection for reentry into the Earth's atmosphere.

In 1963, Bill decided it was time for a change. He stepped down as director of the Aero School after 17 years to found and become director of Cornell's Center of Applied Mathematics. In 1974, he joined the faculty of the University of Arizona in Tucson, where four years later, he was named Professor Emeritus. He remained an active faculty member, however, and completed much of his important analytical and experimental work on adaptive-wall wind tunnels during his retirement.

When he was a junior faculty member at Caltech, he was asked to direct the Civilian Pilot Training Program, a federal program that offered young people the possibility of earning a private pilot's license and receiving preparation for possible military flying in the event that the United States entered the war. Bill not only administered the program but also took the opportunity to get his own license. His move to Cornell allowed him time to fly. Bill logged some 8,000 hours over his 50 years as a private pilot. He owned several small airplanes over the years, the last one his beloved Piper Twin Comanche.

Bill was also an accomplished musician. As a percussionist, he had worked his way through college as a drummer in dance bands. After moving to California, he was a timpanist with the Pasadena Symphony for a few seasons. Later, at Cornell, he became an expert recorder player with a university group interested in medieval music. He played with the Collegium Musicum at the University of Arizona for 20 years and gave a recorder concert to the Cornell Club of Arizona.

Bill was elected to NAE in 1968. He was also honored by the University of Minnesota, American Society for Engineering Education, Israel Aeronautical Society, American Insitute of Aeronautics and Astronautics (AIAA), Royal Aeronautical Society, American Academy of Arts and Sciences, and

International Academy of Astronautics (IAA). He also served on many federal advisory boards, councils, and committees and was a consultant to the aeronautical industry. He was the author of more than 100 articles published in refereed journals.

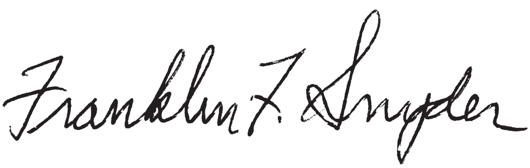
His son, David wrote that "in 1993, Bill published his memoirs: "Stories From a 20th Century Life" (Parabolic Press). A careful reading of this interesting volume reveals no unkind words about any of the persons he worked with over his long career; this was Bill's way of doing business, always upbeat and positive."

He also remembers his father as a wonderful storyteller with a terrific sense of humor, evidenced in this short excerpt from his father's memoirs:

> Having arrived in Pasadena, I met my classmate Thurm Erickson, who drove me to the Caltech campus on California Street; I located the Guggenheim Laboratory of Aeronautics, opened its big copper front door, climbed the narrow stairs to the second floor, and presented myself to the young lady in the little office at the top of the stairs as a new graduate student. She was Miss Mabel Jeanette Rhodes, the department's secretary. We looked into one another's eyes, we gasped, bells rang, and the Guggenheim building trembled! Well, not exactly. That is what should have happened.

Bill is survived by his daughter, Susan Sears, of Indianapolis and son, David Sears, of Bethesda, Maryland; and grandchildren Colin and Shelby Sears, of Portland, Oregon. His wife, Mable died in 2004. He also leaves many friends, colleagues, and former students, whose lives he touched and enriched. William Rees Sears cast a bright, stimulating, and cheerful light on countless people around the world, and he will be sorely missed.

With thanks to Dr. Frank Marble, from whom part of this tribute were excerpted.



FRANKLIN F. SNYDER

1910–2008

Elected in 1985

"For basic contributions to the hydrology and technology of predicting and controlling water level and flow in streams and reservoirs."

BY LLOYD A. DUSCHA

FRANKLIN SNYDER, a noted pioneer and leader in hydrologic engineering for various government agencies and national and international clients, died of cardiac and respiratory failure March 13, 2008, in Peachtree City, Georgia, at the age of 97. He had been considered both nationally and internationally as one of the foremost surface water hydrologists.

He was born November 11, 1910, in Holgate, Ohio, and attended high school in Toledo, Ohio. Upon graduation, he entered the University of Toledo in 1928. In 1930 he transferred to Ohio State University, where he received a bachelor of civil engineering degree in 1932. Subsequently (1942), Ohio State University awarded him a professional civil engineer degree. Although he graduated during the Great Depression, when promising engineers often encountered difficulties finding employment, Snyder obtained work in state and federal agencies.

Snyder's interest in hydrology began as an undergraduate when he co-authored a thesis, "Runoff as a Function of Previous Precipitation," as one of the requirements for his degree. As a junior hydraulic engineer for the U.S. Geological Survey in

1934 and 1935, his work assisting in rainfall runoff studies was published in the Survey's Water Supply Paper 772. Although very young, Snyder gained a reputation for his expertise in the relationship between rainfall and runoff. He continued similar work with the Tennessee Valley Authority in 1935–1937, where he developed flood routing procedures that were applicable to existing and planned reservoirs in the Tennessee River basin. These procedures enabled hydrologists to calculate the course and character of floods as they progressed through a river reach or a reservoir system.

With enactment of the Flood Control Act of 1936, the U.S. government initiated an ambitious cooperative flood control program to protect urban and rural areas. As the program developed, the necessity for reliable hydrologic data became apparent in order to establish reservoir, spillway, and channel capacity and to improve flood forecasting. Given these circumstances, Snyder's innovative work and writings were attracting a wider audience, and his skills were becoming more in demand.

The act also piqued the interest of the states and Snyder joined the Pennsylvania Department of Forests and Waters in 1937 as a hydraulic engineer, where he supervised studies of rainfall and runoff as part of the state's effort to promulgate a statewide flood forecasting and warning plan. While with the Department of Forests and Waters, Mr. Snyder's study of watersheds in the Appalachian highlands led him to develop the concept of a "synthetic unit hydrograph." This was the first meaningful methodology for application of the unit hydrograph theory to ungauged watersheds. Unit hydrographs, as used by Snyder, were discharge graphs for one-inch of surface runoff from a given area for a typical or specified type of storm over a unit of time. A 1938 paper, "Synthetic Unit Graphs; A Concept of Runoff Phenomena, and Predicting Headwater River Stages Directly from Precipitation," published in the *Transactions of the American Geophysical Union* outlined the concept and the procedures. The concept became known as the Snyder Synthetic Unit Hydrograph; the magnitude of this contribution is best illustrated by an observation that essentially every hydrology text published in the ensuing 40 years included the Snyder methodology. Eventually, by analyzing a large number of drainage basins over time, Snyder was able to develop values for the duration of the runoff and flood peaks for different types of basins under varying conditions. His procedures allowed hydrologists to study and analyze drainage basins up to 100,000 square miles in area for which records were not available or were unreliable.

In 1940, Snyder joined the U.S. Weather Bureau in Washington, D.C., as an associate hydrologic engineer responsible for flood forecasting in 75 river districts. During his tenure, his reputation in estimating probable rainfall and runoff and forecasting floods was used in making predictions for the swollen Potomac River. His expertise was considered so critical that when Pearl Harbor was attacked, he received one of only six local weather maps that were produced—the others went to the White House, to Capitol Hill, and the chief of the Weather Bureau. Snyder prepared a thesis on this event entitled "Flood Forecasting for the Potomac River Basin" that described the development and application of flood forecasting procedures. This thesis was used in part for qualifying for his professional engineer degree cited earlier. It is well to note that Snyder made several notable accomplishments relevant to objective methods and procedures for prediction of river and reservoir levels and flood warnings, as well as to the technology and literature, early in his career.

In 1942 the U.S. Army Corps of Engineers persuaded Snyder to join the headquarters staff in Washington, D.C., where he remained until retirement in 1966. He served in progressive assignments culminating as assistant chief of the Hydrology and Hydraulics Branch. His responsibilities involved hydrologic and hydraulic oversight of the Corps' nationwide mission in planning, engineering, construction, and operation of flood control and multipurpose reservoir projects. The duties involved formulating policies and basic procedures, preparing technical instructions and manuals, reviewing field proposals, and developing hydrologic techniques related to flood forecasting methods and reservoir regulation procedures. In addition, he served as a technical advisor to upper management, as well as on major projects such as the St. Lawrence Seaway and Power Project. In 1944–1945 he was on special assignment in Europe supervising flood forecasts of Rhine River stages for assault crossings by Allied Forces.

In summary, Franklin Snyder contributed to both theory and practice of flood hydrology and flood control engineering through significant innovations in (1) the mechanisms of flood peak formations from rain or melting snow; (2) flood routing theory and practice; (3) synthetic hydrology through application of the unit hydrograph; (4) evaporation, particularly from large lakes; (5) understanding the statistical nature of floods and the use of probability in the economic design of flood structures; and (6) spillway design theory.

Mr. Snyder was a prolific writer, particularly in the early stages of his career. In addition to the publications mentioned previously, other treatises published were, "Flood Routing," in the *Transactions of the American Society of Civil Engineers;* "Cooperative Hydrologic Investigations" by the Pennsylvania Department of Forests and Waters, "Storm Runoff," a section in the book *Engineering Hydraulics* by Hunter Rouse, "Large Floods from Melting Snow and Rain and Evaporation on the Great Lakes," in the *Proceedings of the International Association for Scientific Hydrology,* "Synthetic Flood Frequency," and "Spillway Design" in the *Hydraulic Journal of the American Society of Civil Engineers;* and "Floods from Breaking Dams," presented at a workshop of the Water Resources Council.

After retirement from the Corps of Engineers, he continued his profession as a private consultant on government and private projects in Mexico, Columbia, Greece, Jamaica, Canada, Pakistan, India, Sudan, and the United States. The latter assignment included preparing maximum probable precipitation and flood estimates, as well as other hydrologic studies, for the U.S. Nuclear Regulatory Commission. He also served as a board member on the International Joint Commission on the St. Lawrence Seaway and Power Project and on the U.S. National Committee for the International Hydrological Decade, in which he was credited with adding to the prestige and effectiveness of the committee in the United States and internationally.

Other organizational affiliations and honoraria include being elected to the National Academy of Engineering in 1985, fellow of the American Society of Civil Engineers, member of Tau Beta Pi and Sigma Xi, member of the American Geophysical Union and the American Meteorological Society, registered professional engineer and land surveyor in Ohio, named to the Corps of Engineers Gallery of Distinguished Employees, awarded the War Department's Exceptional Civilian Service Award for his contribution on the Rhine River, awarded the James R. Croes Medal from the American Society of Civil Engineers, and receipt of the Outstanding Civil Engineer Alumni Award from the Ohio State University Civil Engineering Alumni Association.

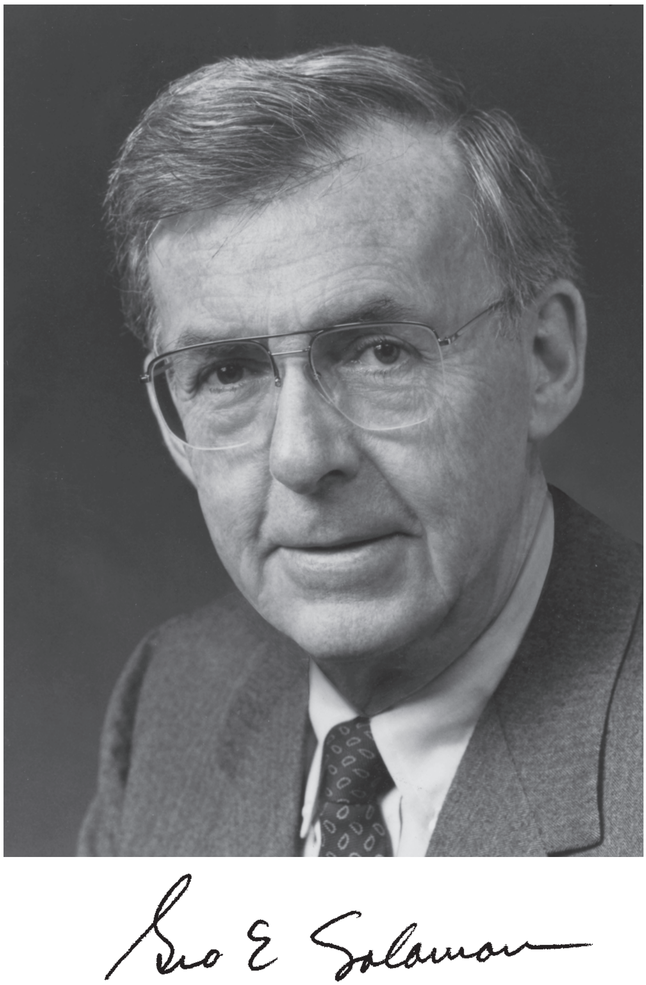
Franklin Snyder was married to Mary Elizabeth Bruton in 1938. She died in 1995 as did a son, Gregory, in 1996. Survivors include Marilyn Kay Stack-Lutz of Peachtree City, Georgia; Carol Garnett of Remington, Georgia; 11 grandchildren and 19 great grandchildren.

His daughters Marilyn Lutz and Carol Garnett wrote:

> Our father was a great parent, wonderful grandfather and kind and gentle great grandfather. He was always thinking of ways to help his family. Dad seemed to know when we needed extra help. No matter how many things were on his schedule for the day, he would fit in our needs. He kept busy with repairing, replacing and building projects for the house. There was nothing he would not tackle.
>
> One of his interests was hunting deer, often going with our brother or friends ("Hobbs or Nunn"). Weather was foremost in his mind, keeping records on rainfall and snow for decades. In addition to tracking rainfall, he would make trips to waterways in Chesterbrook Wood and Four Mile Run in Arlington to observe flooding. Travelling with our mother was on the calendar, combining business trips with pleasure and later, after retirement, to all parts of the world. In later years, his

interests included mastering the use of the computer along with following the stock market and futures trading.

We still think of him every day and wish we could ask him some questions about his life or for advice on some matters. He is greatly missed.



GEORGE E. SOLOMON

1925–2005

Elected in 1967

"For design and development of space and weapon systems."

BY GERARD W. ELVERUM

GEORGE E. SOLOMON, brilliant scientist, engineer, and retired leader of one of the nation's premier astronautics technology and spacecraft products organizations, died on April 25, 2005.

George was born in Ballard, Washington, on July 14, 1925. In high school he was already focusing on engineering and took extra math and physics courses for college credit. He graduated from Ballard High School in 1942 and started attending the University of Washington. World War II interrupted his education plans when he volunteered at age 18 for the U.S. Army. He was severely wounded in 1945 during the Battle of the Bulge after volunteering to carry ammunition forward through heavy mortar fire to front-line infantry troops. Those injuries resulted in the loss of his right leg. He was awarded the Bronze Star for his heroic action, along with the Purple Heart.

After nearly a year of recovery and therapy in army hospitals, George returned to the University of Washington and earned a B.S. degree with honors in aeronautical engineering in 1949. He was accepted at the California Institute of Technology (Caltech), where he awarded an M.S. in 1950. For the next two years he studied under legendary Caltech aeronautics professor Hans Liepman and received his Ph.D. magna cum laude in 1952. Published in 1953, his thesis, "Transonic Flow

Past Cone-Cylinders," developed analytical and experimental data and methods that were subsequently used in the design of aircraft and missiles by several companies in the United States. George's academic achievements were recognized by membership in Tau Beta Pi, Phi Beta Kappa, and Sigma Xi.

In September 1953, Caltech Ph.D.s Simon Ramo (1936) and Dean Wooldrige (1936) formed Ramo Wooldrige, Inc., to pursue avionics systems for aircraft and missiles. By 1954 they set their sights on a much broader role in the evolving ballistic missiles race with the Soviet Union. They won a contract for ballistic missile systems engineering and technical direction from the Air Force and established a Guided Missile Research Division (GMRD) at Wooldridge. Dr. Ramo offered the young new fellow Caltech Ph.D. a job to focus his thesis expertise on the problems of supersonic launch vehicle trajectory control and nose cone reentry thermal protection and design for aerodynamic stability. That began a 33-year career of ever-increasing engineering and management responsibility for George until his retirement from his position as a corporate executive vice president and general manager of the Electronics and Defense Sector of TRW, Inc.

During the period 1954 to 1957, as director of the Systems Research and Analysis Department in the GMRD of Ramo Wooldrige, George had responsibility for the reentry vehicle of the Atlas guided missile. The Atlas was the nation's first intercontinental ballistic missile and was crucial to the U.S. defensive position versus the aggressive and belligerent Soviet Union during what became the start of the 40-year Cold War. In addition to his management responsibilities, he personally developed analyses of ablation of nose cone materials and dynamic trajectory dispersion of reentry vehicles. These technologies were exploited later in other U.S. missiles such as Thor, Titan, and Minuteman. National Aeronautics and Space Adminstration (NASA) programs such as Mercury, Gemini, and Apollo also benefited from the technologies in both launch vehicle and reentry vehicle design.

In 1957, GMRD was reorganized as the Space Technology Laboratories (STL) of Ramo Wooldrige, and George was appointed director of the Systems Analysis Laboratory for STL, which in 1958 became the Aeromechanics Laboratory. As part of this role, he directed research on the critical effects of high-energy radiation and particles in space on the thermal control surfaces and solar cells of spacecraft. In the late 1950s and early 1960s, George's organization managed the systems engineering of several of the earliest successful U.S. spacecraft, including *Able IV* and V, NASA's interplanetary Pioneers, and the Orbiting Geophysical Observatory. In addition to scientific spacecraft, George had overall management responsibility for system design of one of the first U.S. defense satellites, *Vela,* to monitor for nuclear explosions on the ground and in space. These early space systems directly led over the next 50 years to STL's (later TRW's) diverse large family of scientific spacecraft systems for NASA and many military and surveillance satellites crucial to the nation's defense. Simon Ramo stated at the time that "George possessed a combination of personality, leadership, technical background, and integrity that made our team complete."

In May 1965, Space Technology Laboratories became TRW Systems Group, with Ruben Mettler as president. In 1970 George was made vice president and general manager of the Systems Group. George's 25 years of leadership and managerial accomplishments for TRW, and his engineering stature in both the United States and internationally was recognized by TRW's board of directors in 1981 when the board appointed him as a corporate executive vice president and made him general manager of the new Electronics and Defense Sector of TRW. This major business sector employed almost 40,000 scientists, engineers, and technical support and business management personnel in eight operating groups, with laboratories, manufacturing facilities, engineering test sites, and offices throughout the world.

Dr. Solomon was elected to the National Academy of Engineering (NAE) in 1967. He was an early chairman of the Aeronautics and Space Engineering Board of the National Research Council (NRC). In 1986–1987 he was chairman of the NAE Aeronautical/Astronautical Engineering Peer

Committee and also a member of the Committee to Perform Post-*Challenger* Assessment of Space Shuttle Flight Rates. Following his retirement from TRW, he served as a member of the Board on Army Science and Technology from 1988 through 1990 and from 1990 to 1992 was a senior member of the NRC's Strategic Technologies for the Army study.

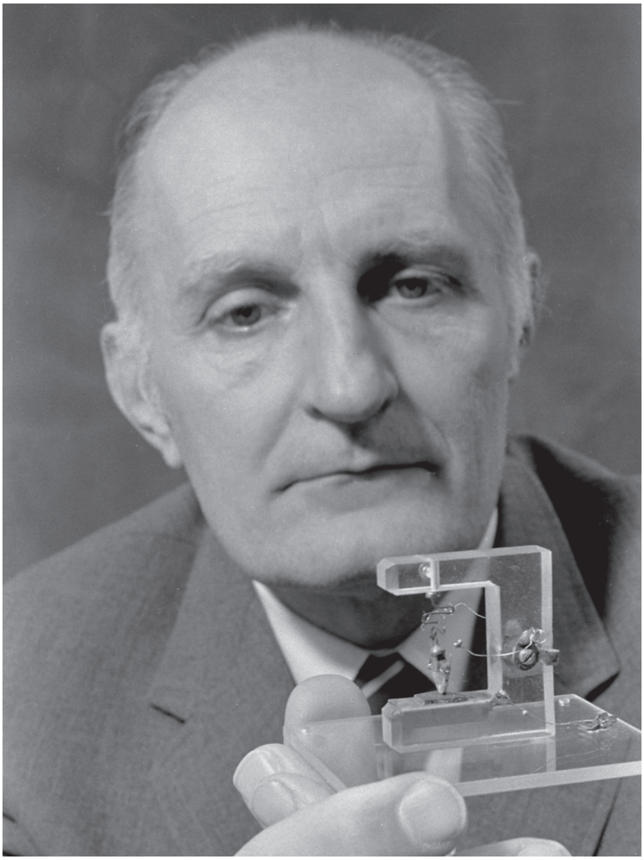
George was a member of the board of governors and chairman of the aerospace technical council of the Aerospace Industries Association. He was elected a fellow of both the American Institute of Aeronautics and Astronautics and the American Astronautical Society. George's service to his country continued over the years through membership in the Armed Forces Communications and Electronics Association, Air Force Association, Association of the U.S. Army, Electronic Industries Association, National Security Industrial Association, Armed Forces Management Association, National Contract Management Association, and Veterans of Foreign Wars.

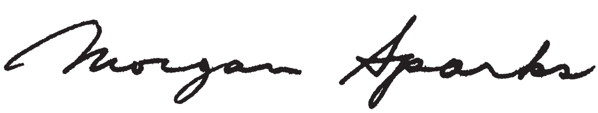
Dr. Solomon also maintained an active interest in the academic life of both of his alma maters—the University of Washington and the California Institute of Technology. He was a member of the engineering advisory group at the University of Washington and established the George E. Solomon Prize for Aerospace Engineering at the University of Washington for exceptional student performance. He received a University of Washington Distinguished Alumni Award in 1984. George also was honored with a Distinguished Alumni Award from Caltech in 1983.

In January 1959, I left Caltech's Jet Propulsion Laboratory to join George's Aeromechanics Laboratory at STL as head of the Advanced Propulsion Section. For the next 28 years until his retirement from TRW in 1987, it was my good fortune and privilege to carry out my career in organizations under the management of this brilliant scientist and engineer. George was more than a manager; he was a leader of the highest integrity and a gentle man who provided friendship and support to those who worked with him. His encouragement and guidance over all those years energized my efforts on many difficult occasions, and I will always remember him with great fondness.

George married his second wife, Karen, in 1985. Following his retirement in 1987, they moved to the Santa Barbara suburb of Montecito, California. He and his wife joined the Greek Orthodox Church of Santa Barbara and, as one could have predicted, George became president of the parish council. While there, once again in typical service to the country he loved, he undertook reading technical books for Recordings for the Blind. In 1995 he and Karen moved to Boise, Idaho, where he lived the remaining years of his exceptional life. George E. Solomon passed away on April 25, 2005. He is survived by his wife Karen (who still lives in Boise); his son Cleve (a Caltech Ph.D.) and daughter Jane from his first marriage; his stepdaughter Denise; three grandsons, Derek-Lee, Troy, and James; and his sister Carmella and brother-in-law Bill.

George Solomon should be eulogized by recognition that from the time he left a leg at the Battle of the Bulge in World War II through 30 years of developing major missile and spacecraft systems critical to the defense of this nation, and additional years of aiding his fellow handicapped and underprivileged citizens, his life was dedicated to the service and protection of his country. He certainly deserves to be remembered as a premiere example of what has come to be designated in the United States as "The Greatest Generation."





MORGAN SPARKS

1916–2008

Elected in 1973

"For pioneering work in the invention of the grown junction transistor."

BY WILLIAM MURPHY
SUBMITTED BY THE NAE HOME SECRETARY

MORGAN SPARKS, the man who "invented" the Sandia National Laboratories we know today, died on May 3, 2008, at his daughter's home in Fullerton, California, at the age of 91. Morgan had a distinguished 30-year career with Bell Laboratories, and is best remembered for his role in developing the first "grown-junction transistor," the semiconductor device recognized as one of the first building blocks of the digital age.

Born in 1916 in Pagosa Springs, Colorado, and raised in Texas, Sparks received his bachelor's and master's degrees in chemistry at Rice University before earning his Ph.D. in physical chemistry from the University of Illinois in 1943. That same year, he began his long tenure at Bell Telephone Laboratories in Murray Hill, New Jersey, working on batteries for naval torpedoes in the Electrochemical Research Department. In 1948 he joined the new Bell Labs Semiconductor Physics Group, just as it was about to announce the invention of the first transistor. As a member of this group, Morgan made seminal contributions to the development of the junction transistor conceived that year by physicist William Shockley.

Working closely with chemist Gordon Teal, Sparks developed a more practical means of fabricating junction transistors by adding tiny amounts of specific impurities to germanium crystals during their growth process. Called the "grown-junction transistor," this breakthrough was announced by Bell Labs on July 4, 1951. Shortly thereafter, Shockley, Sparks and Teal published these results in a now-famous paper in *Physical Review.*

In 1955, Sparks became a Director of Solid State Research at Bell Labs, and advanced through its management ranks, becoming Vice President of Electronics Technology by 1971. In these capacities, he led efforts to develop silicon integrated circuits for the Bell Telephone System.

Sparks was the last surviving member of the original Shockley group at Bell Labs. Ian Ross, president of the Labs from 1979 to 1991, put Sparks' work on the transistor in perspective. "In a very real sense . . . Morgan's work . . . completed the innovation that was the invention of the transistor." Ross, who first met Sparks in 1952 and remained a lifelong friend, added: "In everything he did . . . Morgan was always a calm, constructive, and good-tempered person. But that suggests one more outstanding attribute, his ever-present sense of humor. Those who have known him have indeed been privileged."

Morgan's career at Bell Labs ensured his place in the history of American science and technology, but he also left his mark in Albuquerque on the hearts and minds of a generation of Sandia researchers. When Senator Pete Domenici (R-N.M.), who was elected to the Senate the same year (1972) Morgan became Sandia director, learned of his passing, he said, "Morgan Sparks set a high standard for the professional, efficient management of Sandia National Labs. He recognized the future need to channel lab science into technology transfer, and he laid the groundwork to link defense-based research to applications that now impact our lives every day. I credit Dr. Sparks for working to make Sandia one of the best-run labs in the nation. He was my friend."

When President Harry S. Truman established Sandia in the late 1940s, he recruited American Telephone & Telegraph

Company (with the famous injunction to "render an exceptional service in the national interest") to manage the institution. But the modern Sandia, the multiprogram national laboratory that develops technical solutions to the nation's most pressing national security challenges, that Sandia is the invention of Morgan Sparks, who came to Sandia in 1972 and served as director until his retirement in 1981.

Throughout the 1950s and 1960s, Sandia was a sharply focused, single-mission laboratory—and the mission was nuclear weapons. Sandia enthusiastically embraced Truman's charge and put forth often heroic efforts in the monumental task of building America's strategic deterrent. By the 1970s, however, policy makers sensed that the pace of investment in the nuclear weapons program could be relaxed a bit. Thus just a few months after Morgan became director, Sandia experienced the largest cutback in its history. Fully 10 percent of its workforce was laid off within a six-month period, and the future of the laboratory was uncertain.

Morgan, however, had no intention of presiding over the slow demise of this unique institution. He understood that the capabilities developed at Sandia to fulfill its nuclear-weapons mission could be applied to a host of other challenges. After the wake-up call to international terrorism during the 1972 Munich Olympics and the energy crisis of 1973, Sparks concluded that, "The nation had urgent needs, and Sandia could help."

As a veteran of Bell Labs, Sparks had long since learned that solutions could be found to even the most formidable challenges. When pressed by the media to speculate on Sandia's prospects, he confidently told reporters that it would continue to thrive even as spending on weapons declined. Sandia, he said, would seek new programs "to add stability to our future workload and to provide diversity in our technical programs."

By the end of the 1970s, Congress had validated Sparks' vision, conferring national laboratory status on Sandia. With 7,700 employees, it was not only the largest of the three nuclear weapons labs, but also the one with the most diverse mission portfolio. Sparks continued to look ahead with his usual optimism. "The nation is entering the '80s with much apprehension. Beyond the state of the economy, the two biggest problems we face are the adequacy of our national defense and our energy supply. We at Sandia have a marvelous opportunity to contribute to both of these challenges. What more could we ask for?"

Upon learning of Sparks' death, Sandia's current president and director, Tom Hunter, said, "Morgan was president when I was a young staff member at Sandia. . . [He] was a great American and a respected leader in our community . . . I spent some time with him at the Nevada Test Site in the early '70s and will always remember how this renowned researcher from Bell Labs so quickly and thoroughly immersed himself in every aspect of our weapons work. He was a credit to the lab, and, true to our mission, [he] provided exceptional service to the nation."

In an interview after his retirement for *Recollections for Tomorrow,* a special 40th-anniversary Sandia publication, Sparks reflected on what it meant to be a Sandian. "For some time here [at Sandia] the vice president for research was brought out from Bell Labs . . . to keep those bonds [between Bell Labs and Sandia] . . . a kind of corporate culture evolves [that] encourages researchers to thoroughly understand their subject, write papers, publish, become known, get to know other fundamental workers in the field . . . The feeling was that if you're going to do research in a field, you have to do it in a thorough, fundamental way. Those things were enormously influenced by Bell Labs.

"Sandia has its own culture . . . one of the things Sandia did was emphasize integrity . . . [it never] promised something it couldn't deliver . . . Every organization has some history and background, and Bell Labs in particular and the Bell System in general played an important role in the evolution of Sandia. But Sandia is a first-rate, world-class laboratory in its own right."

Jack Howard, who served as Morgan's executive vice president from 1973 to 1981, recalled the many dimensions of the man. He wrote in an e-mail to the Sandia Lab News, "The transistor won Nobel prizes for three physicists at Bell Labs, but it wouldn't have worked without the epitaxial layer Morgan cooked up for them. . . . At Sandia, Morgan quickly [learned] the weapons business. Sandians know the great job he did while he was here."

Orval Jones, Sandia's executive vice president in the 1980s, recalled that "working for him was a pleasure." Sparks, he said, "was modest, soft-spoken, and analytical, but he was also a decisive, supportive, action-oriented leader. An attentive listener, he was friendly and approachable—always courteous and considerate."

Al Romig, now Sandia's deputy laboratories director,[1] was a young staff researcher in the 1970s. "You can't imagine what an inspiration it was for us to have a scientist of Morgan's stature at the head of this laboratory. His very presence lent huge credibility to our own work . . . But for all . . . his accomplishments as a researcher and as a technical manager at Bell Labs, Morgan was eminently approachable . . . in recent years as an Emeritus member at Sandia, I was deeply. . . moved that his interest and passion for the lab remained intense throughout his retirement."

In 1981, Sparks accepted an appointment to the Robert O. Anderson School of Management at the University of New Mexico, where he was dean until 1984. He was also active in Albuquerque civic life, serving as chair of the United Way and the Police Commission Task Force. He led the effort to continue activities at Kirtland Air Force Base and served on the boards of Presbyterian and Lovelace hospitals, the New Mexico Symphony Orchestra, and the Albuquerque Academy. Until 2007 he was president of High Desert Investment Corporation, the developers of the High Desert and Mariposa communities.

At Bell Labs, Morgan got to know Bill Shockley's secretary, Elizabeth "Bette" MacEvoy. As a guest at their wedding in 1949, Shockley arranged to have the rear axle of the newlyweds' getaway car raised just enough to preclude traction. They were

1. Al Romig is now Skunk Works Vice President of Advanced Development Programs at Lockheed Martin.

married for 57 years until Bette's death in 2006. The couple is survived by four children, Margaret Potter and Gordon Sparks, both of Waitsfield, Vermont; Patricia Fusting of Fullerton, California; and Morgan Sparks, Jr., of Burlington, Vermont.

JOHN E. STEINER

1917–2003

Elected in 1978

"For leadership in the design of commercial transport aircraft, including the Stratocruiser, 707, 727, 737, and 747."

BY JOHN D. WARNER

JOHN EDWARD "JACK" STEINER died in a swimming accident in Lake Washington on July 29, 2003. Honored as the "father of the 727," he lived in Medina, Washington. He was 85.

Jack Steiner began his 43-year career at Boeing in 1941 after earning a master's of science degree in aeronautical engineering from the Massachusetts Institute of Technology and a bachelor of science degree in aeronautical engineering from the University of Washington.

During his career at Boeing he played a major role in the design, development, and marketing of every commercial plane from the Stratoliner to the 767. Recognized as one of aviation's greatest designers, Steiner was in charge of aerodynamics on the design of the 707 and was chief engineer for the 737 program and also chief engineer and program manager for design and development of the best-selling 727.

Steiner was known for being energetic and hard working, attributes that contributed to his success as general manager of the 707/ 727/ 737 division. While heading that division, he saw the company through one of its bleakest period during the early 1970s, when two-thirds of the market vanished and combined production rates for the 707, 727, and 737 dropped to a mere four planes per month.

Steiner consolidated the manufacturing of all three single-aisle planes and managed to produce them at a profit. In 1973 he was appointed vice president of program operations for Boeing Commercial Airplane Company. Before his retirement in 1984, Steiner contributed to development of the 757 and 767 and was elected vice president of corporate product development.

In 1981 he was selected by the President's science advisor as the sole industry participant in the White House Aeronautical Policy Study and went on to become chairman of the Aeronautical Policy Review Committee for the Office of the President of the United States. He retired from that position in 1990.

A brilliant engineer, Steiner worked on high-technology research involving aerodynamic efficiency of swept wings and total commercial and military configurations, structural efficiency and durability, propulsion integration, and computer-aided productivity improvement research in engineering and manufacturing. He was the tough point man for production and was quoted as saying, "If we don't have a few problems, we'll die of comfort." He received numerous national and international awards, including fellowship in the Royal Aeronautical Society and the American Institute of Aeronautics and Astronautics, and was selected twice as *Aviation Week's* "Man of the Year." In 1978 he was honored as Alumnus Summa Laude Dignatus, the highest award the University of Washington bestows on a graduate.

His daughter Christine Schwager wrote:

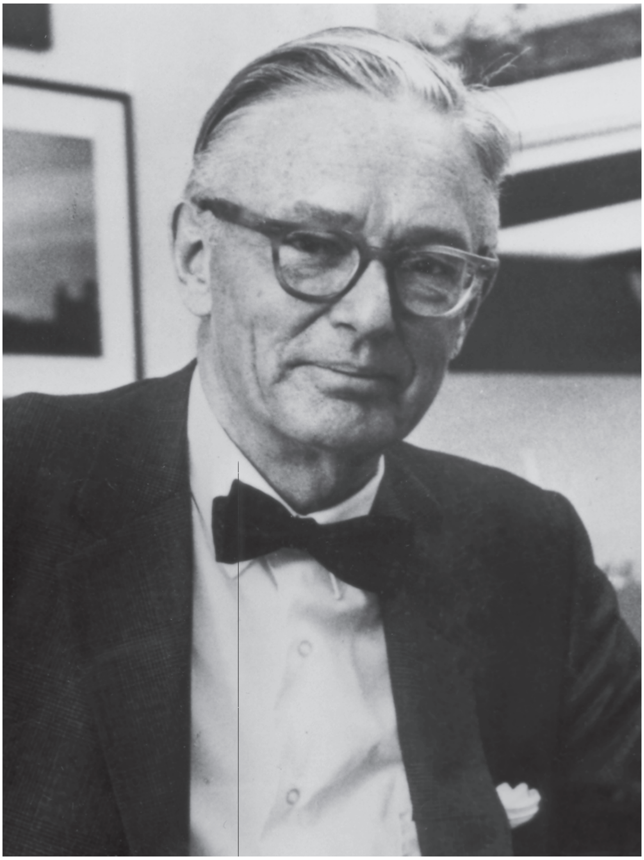
> Jack's wife of 60 years, Dorothy, passed away in January, 2003. They were survived by three children and five grandchildren. Their oldest son, George, died in November of 2003, leaving his wife Carlyn and daughter Joanna as survivors. Jack and Dorothy's remaining

children include Christine Schwager (husband Bruce, children Dan and Karen) and son John Steiner (children Jeremy and Nicholas).

My dad loved boats. As a child he built model sailboats, and during high school he rebuilt an old sailboat he named the *Rogue*. He had dreamed of designing boats as a career, but the airplane business was booming so he decided to become an airplane engineer.

Our family spent part of almost every summer cruising in British Columbia first on a 34′ cruiser and later on a 53′ custom designed ketch. My parents explored and sailed with their boat every year until they died. My parents' love of sailing, fishing, beachcombing, swimming, skiing, and exploring the world was passed on to their children and grandchildren.

My father had an active, curious, and creative mind. He was a prolific writer and an accomplished public speaker. He was an avid reader and liked the challenge of big ideas. He was always eager to teach what he knew and listen to what his children and grandchildren had to say. I learned something new at every meal, and my children say they have learned much from their grandpa.



OLIN J. STEPHENS II

1908–2008

Elected in 1994

"For advancing knowledge and research in naval architecture, particularly in the outstanding design and technology of sailing yachts."

BY J. NICHOLAS NEWMAN

OLIN STEPHENS died on September 13, 2008, five months after celebrating his 100th birthday. During his long career he was the preeminent designer of sailing yachts. He was regarded with great respect and affection by naval architects and sailors throughout the world.

Olin was born in New York City on April 13, 1908. He and his brother Rod learned to sail small boats during their childhood, and this experience molded their careers. Olin attended MIT in 1926–1927 but his formal education was interrupted by jaundice, and he chose to work thereafter without further academic study. He quickly achieved recognition and professional success, based on his astute intuition and industry.

After a short apprenticeship working with naval architects in New York, Olin formed a partnership with the yacht broker Drake Sparkman. At the time Olin was only 20 years of age, with the responsibility for all design work. After his 21st birthday the firm Sparkman and Stephens was incorporated. It became known throughout the sailing world as "S&S". Olin's first designs included a fleet of day sailers which are still racing on Long Island Sound, a small ocean-racing sloop in which he placed first in his class in the 1929 race from New London, Connecticut to Gibson Island, Maryland, and several boats in the highly competitive international Six-Metre Class.

The 52-foot yawl *Dorade* was a defining point in Olin's career. Designed for his father in 1929, *Dorade* was a revolutionary boat with narrow beam, a deep keel, and an efficient rig for sailing to windward. In 1931 *Dorade* won the trans-Atlantic race from Newport, Rhode Island to Plymouth, England by a dramatic margin, finishing two days ahead of larger boats. Olin sailed as skipper with his father, brother and four friends. They went on to win the Fastnet Race before returning to New York, where they were welcomed by the mayor with a ticker-tape parade up Broadway. In 1933 Rod returned to England on *Dorade* to win the Fastnet Race again. The success of *Dorade* brought many clients to S&S. Olin's designs dominated ocean racing for the next 50 years, not only in the United States but throughout the world. Many of these boats are still actively sailed.

Rod joined S&S in 1933 and the two brothers worked as an efficient team thereafter. Throughout the 1930s they designed a wide variety of boats. Several evolutionary developments from *Dorade* were winners in the Bermuda Race, Fastnet Race, and 1935 trans-Atlantic Race. For the America's Cup races in 1937 Olin was invited to collaborate with Starling Burgess designing *Ranger*, a breakthrough boat which defeated the British challenger in four straight races. *Ranger* was the last of the J-boats, 134 feet long overall with a displacement of 165 tons and 7500 square feet of sail area. She was built by Bath Iron Works in Maine. Olin and Rod were members of her racing crew.

In 1933 Olin began a momentous collaboration with Professor Kenneth Davidson of Stevens Institute of Technology. Davidson was developing techniques for testing small-scale models of sailing hulls, initially in the swimming pool at Stevens and later in a small towing tank. Correlations with the performance of full-scale boats required measurements of the drag and lateral (lift) hydrodynamic forces on the model, and of the corresponding aerodynamic forces on the sails. Olin and Rod made full-scale measurements on the sloop *Gimcrack*, and Davidson analyzed this data to derive aerodynamic force coefficients for the sails. Olin made shrewd use of these results in his subsequent designs, many of which were tested in the Stevens towing tank. In the case of the 1937 America's Cup four competing hull designs were produced by Stephens and Burgess, and the final design was selected based on tests in the towing tank. With characteristic modesty Olin broke their agreed silence after Burgess died, to correct the erroneous presumption that Stephens had designed the hull that was selected for *Ranger*.

Between 1939 and 1945 the design and construction of naval vessels occupied Olin and his expanded staff. Their most important projects were a class of 110-foot submarine chasers, the DUKW amphibious vehicles, and aluminum pontoon bridges. During these years Olin had to deal with the management of a staff of over one hundred people, and the bureaucracy of their military clients.

After World War II S&S resumed work on yachts. Important early designs included *Bolero*, a magnificent 72-foot yawl, and the 38-foot centerboard yawl *Finisterre* which won three consecutive Bermuda Races. In the 1960s and 1970s S&S designs evolved with higher aspect-ratio keels and separate rudders. Construction shifted from wood to aluminum and fiberglass-reinforced plastic. Competition for the America's Cup was resumed in 1957 with yachts designed to the Twelve-Metre Rule. S&S designed all but one of the American boats selected for this competition before Olin retired in 1978.

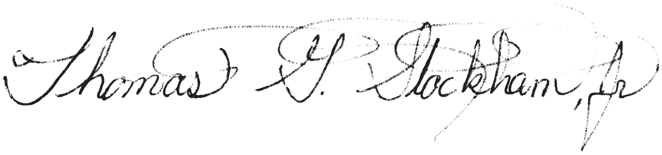
The design of yachts is strongly influenced by the rating rules under which they race. Conversely, rational development of rating rules requires a deep knowledge of yacht design, including the hydrodynamic and aerodynamic principles which govern a yacht's performance under varied conditions. Olin took a keen interest in the development of the rating rules used for ocean racing, and the more restricted rules used for the America's Cup. He contributed his time and expertise to numerous national and international committees responsible for these developments. The rating rules developed prior to 1970 were empirically based, usually expressed by simple algebraic formulae with coefficients arrived at by the respective committees. More rational rules and handicap systems were developed in the 1970s, based on computer simulations using hydrodynamic and aerodynamic predictions of the hull and sail forces. Olin was an enthusiastic supporter of these procedures, and his backing was crucial in their acceptance.

Olin served as a mentor for many younger engineers who worked at S&S, and for others who were inspired by his accomplishments and benefited from his encouragement. He was characteristically modest, especially with regard to his academic training, and dogmatically encouraged aspiring yacht designers to study engineering and mathematics.

After his retirement Olin continued to work on special projects with S&S, and on committees responsible for rating rules. He was critical of the trend toward ocean racers with light displacement and wide beam, due to their limited range of stability. After the disastrous Fastnet Race in 1979 he worked with a small technical committee to develop rational guidelines for the safety of ocean-racing yachts. He traveled extensively and was present at many America's Cup races and other yachting events. His professional reputation and warm personality endeared him to sailors and yacht designers all over the world. With the encouragement of friends and former clients he wrote *All This and Sailing, Too*, an autobiography published in 1999. (I acknowledge this source for several details in the paragraphs above.) In 2002 his second book *Lines* was published, containing the lines plans and Olin's retrospective comments on some of his favorite designs.

In 1959 The Society of Naval Architects and Marine Engineers presented to Olin its foremost award, the David W. Taylor Medal. In 1993 he was awarded the Gibbs Brothers Medal by the National Academy of Sciences "For his design of outstanding sailing vessels, including six defenders of the America's Cup and thousands of ocean-racing yachts, and for promoting the use of scientific knowledge and research in the field of naval architecture." In 1994 he was elected to the National Academy of Engineering. He received honorary degrees from Brown University, Stevens Institute of Technology and the University of Venice (Italy), and numerous awards from yachting organizations.

Olin married Florence Reynolds in 1930. After his retirement in 1978 Olin and Susie lived in Vermont near their sons Olin III and Samuel. Later they moved to a retirement community in Hanover, New Hampshire, where Susie died in 1993. Olin continued to travel and participate in activities related to yacht design. At the time of his death he was working on the redesign of one of his early ocean racers, in collaboration with a naval architect at S&S.



THOMAS G. STOCKHAM, JR.

1933–2004

Elected in 1998

"For contributions to the field of digital audio recording."

BY ALAN V. OPPENHEIM

THOMAS G. STOCKHAM, JR., professor at the University of Utah and widely regarded as the father of digital audio, died on January 6, 2004, at the age of 70. Professor Stockham was born on December 22, 1933, in Passaic, New Jersey.

Tom was elected to the National Academy of Engineering in 1998. His career was strongly influenced by his love for teaching, music, perfection, and family and by his incredible skills as an engineer. He received all of his degrees in electrical engineering at the Massachusetts Institute of Technology and was appointed as an assistant professor at MIT in 1959. In the mid-1960s he joined the research staff at MIT's Lincoln Laboratory, and in 1968 he joined the faculty at the University of Utah where he helped establish its computer science department. Early in his academic career at MIT, Tom worked closely with Amar Bose, founder of Bose Corporation, on the use of digital computers for measurement and simulation of room acoustics and for audio recording and enhancement. Through this work he became a pioneer in the field of digital signal processing, a technology that in the 1960s was totally impractical for real-time applications since the processors could fill (and heat) a room, and clock speeds were extremely slow by today's standards. It was partly through Tom's pioneering work on digital signal processing algorithms that this technology eventually emerged as critical to virtually all modern communication and multimedia systems.

In the mid-1970s Tom was one of six technical experts appointed by Judge John J. Sirica of Federal District Court to examine the now-famous Watergate tapes made in President Richard Nixon's office. The technical panel was charged with determining what caused the 18½-minute gap and to attempt to recover what was apparently erased. During that investigation, Tom became well known for his calm and expertise on the witness stand. At one point he was asked under cross-examination by attorney James St. Claire something along the lines of the following: "Now, Professor Stockham, do you seriously think that anything meaningful could be said within a few-second interval?" Tom replied, "You bet!"—and then kept silent. The panel eventually reported that the famous gap was caused by at least five separate erasures and rerecordings, not by a single accidental pressing of the wrong button on a tape recorder, as the Nixon White House had suggested.

In a 1981 interview with *The New York Times*, Tom commented that he began working on digital recording of music in 1962 but that the technology for commercial recordings was not ready until the early 1970s. In 1975 he cofounded Soundstream, Inc., a company dedicated to high-quality digital recording and remastering of audio. In 1976 Soundstream made the first live digital recordings, featuring the Santa Fe Opera, and demonstrated them at the 1976 Audio Engineering Society meeting.

Among other notable successes was the release by RCA of "Caruso: A Legendary Performer," the first in a series of famed opera singer Enrico Caruso's recordings that were remastered. The result, as reported in the press, was "stunningly clear and clean restored recordings of the great Italian tenor." Also quite astonishingly, Tom was able to separate the singing from the orchestra with the eventual possibility (unrealized) of having a new orchestra dubbed in. In 1980 Soundstream merged with Digital Recording Corporation. With Tom's success in digital recording and remastering, digital audio generated an enormous following of strong adherents but also an active and vocal opposition, even giving rise to a group called Musicians Against Digital, since some felt that sound quality would suffer. One particularly vocal opponent, a medical practitioner, continually made the claim that digital music would be a health hazard (perhaps, I guess, because of the sharp edges on the bits?) with direct reference to what Soundstream was accomplishing.

In 1982–1983 Tom was president of the Audio Engineering Society. Throughout his career he was recognized for his many extraordinary accomplishments. In 1988 he received an Emmy Award for his work on tapeless audio and editing systems, and in 1994 he received a Grammy Award for his "visionary role in pioneering and advancing the era of digital recording." In 1999 he was corecipient of an Oscar, a Scientific and Engineering Award from the Academy of Motion Picture Arts and Sciences for work in digital audio editing. His many other awards and recognitions included MIT's prestigious Goodwin Medal for conspicuously effective teaching, election as a fellow of the Institute of Electrical and Electronics Engineers, the IEEE Jack S. Kilby Signal Processing Medal, the Gold Medal from the Audio Engineering Society, the Poniatoff Gold Medal from the Society of Motion Picture and Television Engineers, and election to the National Academy of Engineering.

As expressed to me by his family, at home Tom was a loving husband to Martha Goodman Stockham and a dedicated father to four children—Tom III, Carol, John, and David. His love of the outdoors and the grandeur of the American West meant frequent family vacations were spent exploring the natural wonders of the region, albeit with the soul of an incurable engineer. Tom loved the geysers and wildlife of Yellowstone National Park, where with meticulous precision he tracked the geysers' activities, frequently helping the National Park Service better understand the area's thermal activity. He loved the geology and stunning formations of Southern Utah, where he easily recognized by name and character every one of dozens of layers of sandstone and could predict what types of arches and ruins might be found around a new hike's every corner.

He especially loved the deep, sinuous canyons of Lake Powell, where he combined his lifelong love of boating with his love of exploring places that few people will ever experience. There he also used a tuning fork to more precisely set his boats' engine speeds (because the tachometers that came with the boats were not precise enough). He spent countless hours with an eye to a telescope under the breathtaking night skies of the high desert, where eventually he helped bring more precision to our understanding of when Polaris will align with the North Pole. Tom was also an accomplished pilot and certified aerobatics instructor and an expert skier.

Above all, Tom was a deeply caring husband, father, teacher, and mentor, sharing his passion and knowledge with his family, his students, his co-workers, and anyone who cared to soak in all that he had to offer.

As expressed in Salt Lake City's *Deseret News*: "Tom was a man of highest integrity and deepest love. He spent his life in the pursuit of knowledge that would enhance the world, and lived his life in joyful exploration that extended to everyone around him. Often those with whom he interacted commented that he could explain the most complicated concepts with ease and clarity, displaying not only an enormous and uncanny intellect but also a keen ability to relate to his listeners and communicate to their level of understanding. His kindness was unconditional and pervasive."

I personally had the pleasure and opportunity of meeting Tom when I was a graduate student and he was just returning from the Air Force to begin his academic career as a junior faculty member at MIT. He was a close personal friend and mentor, and I was privileged to personally experience and benefit from his many wonderful and unique abilities and qualities. There is a large community within and outside the National Academy of Engineering whose lives and careers were touched and enhanced both directly and indirectly by Tom Stockham.

BRUNO THÜRLIMANN

1923–2008

Elected in 1978

"For accomplishments in theory, research, and design, and construction of steel, reinforced concrete, and prestressed concrete."

BY JOHN E. BREEN

BRUNO THÜRLIMANN, professor emeritus of structural engineering at the Swiss Federal Institute of Technology in Zurich and a visionary, pioneering expert on engineering applications of plasticity theory in both steel and concrete structures, died on July 29, 2008, at the age of 85. Bruno Thürlimann was elected a member of NAE in 1978 "for accomplishments in theory, research, design and construction of steel, reinforced concrete, and prestressed concrete structures."

In November 1850, when President Zachary Taylor signed a Convention of Friendship, Commerce and Extradition between the United States and Switzerland, he said it was his hope that "the two freest peoples on earth will treat each other reciprocally on a footing of equality." A century later, Bruno Thürlimann, who was born a Swiss citizen and became a naturalized American citizen in 1957, was the embodiment of a bridge between the two nations for transferring technical ideas between the two worlds and improving structural engineering in both. A warm, compassionate, open-minded teacher and researcher, he brought scientific ideas and rigorous mathematical theories from Europe to underpin the highly empirical base of North American structural design. And he brought nonlinear and plastic approaches for structural design back to Switzerland. Throughout his career, he was a truly international presence, a highly respected lecturer, and a consultant worldwide.

He was born on February 6, 1923, to a family with a tradition in medicine in Gossau, St. Gallen, Switzerland. In 1935, he entered the Jesuit boarding school Stella Matutina (Morning Star) in Feldkirch, Austria, where two elder brothers, his father, and his grandfather had been educated. The Jesuit *ratio studiorum*, which emphasized intellectual, literary, philosophical, social, and scientific training and included sports, such as swimming, hiking, and skiing, was designed to teach skills, foster democratic leadership, and create *esprit de corps*. This course of study had a formative influence on Bruno as a future leader. Unfortunately, after the Anschluss of 1938, the Nazi persecution of the Jesuits resulted in the closing of the school. Thürlimann transferred to the College St. Michael in Fribourg where he obtained his Swiss *Matura.*

Thürlimann chose to study civil engineering at the famous Swiss Federal Institute of Technology at Zurich (ETHZ), but his studies were repeatedly interrupted by military service to defend Switzerland's neutrality during World War II. After receiving his engineering diploma in 1946, he was an assistant at ETHZ for two years. He then continued his studies at Lehigh University in Pennsylvania where he did graduate work on cylindrical shell roofs with Professor Bruce Johnson and received his Ph.D. in 1951.

In 1951–1952, Bruno was a research associate in William Prager's Division of Applied Mathematics at Brown University, the same years Prager and his colleagues published the theorems that provided the theoretical basis for the limit design of beams and frames. When Bruno returned to Lehigh as a Research Professor in 1953, he played a key role in the revolutionary development of radically new methods of designing with structural steel based on nonlinear material and geometric models. The limit-design approaches required greatly improved knowledge of local and lateral stability of severely plasticized portions of steel beams and columns. Bruno developed design techniques for steel elements in compression and welded steel-plate girders that are still essential to all modern steel design codes. In recognition of his work, the American Society of Civil Engineers awarded him the Norman Medal in 1963 for a paper on inelastic instability of steel structures and the Mosseiff Award in 1964 for a paper on the bending strength of welded-plate girders—both key elements in the new design technologies for steel structures.

In 1960, Bruno dramatically switched gears when he returned to ETHZ as chair of structural concrete, a position he held until he became Professor Emeritus in 1990. Applying his intimate knowledge of plasticity to steel structures, he conceived a systematic application of plasticity for reinforced and prestressed concrete, materials that are much more limited by strain than steel. Entrenched senior faculty, enamored with the beauty and consistency of elastic theory, considered his plasticity theory and its implications a sacrilege. Staying well within the limits of politeness and respect, Bruno summoned his powers of logic, rigor, and inventiveness in extending plasticity to encompass all combinations of axial load, flexure, shear, and torsion in both reinforced concrete and prestressed concrete; eventually, he convinced students, practitioners, and regulatory authorities. His theories were rigorously based and were confirmed by carefully conceived large-scale experimental research.

In later years, he extended the plasticity theory to masonry structures. He lectured widely and, in time, his plasticity approach to structural concrete was accepted as an important element for design codes in Switzerland, Europe, and the Americas, particularly when combined flexure, shear and torsion actions were considered.

Throughout his career, Thürlimann was much in demand as a consultant on major engineering projects. Unlike many "academic" engineers who do not relate well to the "dirty" reality of everyday engineering, he quickly grasped the essence of complex situations, regardless of whether the complexity arose from a technical issue or financial or business considerations. He was called on for important decisions on projects as diverse as the CN Tower in Toronto, the record-setting Gateway Bridge in Brisbane, the overly flexible John Hancock Building in Boston, the Louvre Pyramid, and the forensic investigation and redesign of the Norwegian Contractors Sleipner A Platform, which had caused a $700 million loss when it imploded during construction.

Throughout his career, Bruno opened new worlds for his students and colleagues. He held daily coffee meetings for everyone in his institute and ski excursions and institute swims across the Lake of Zurich to built spirit and continuity among his assistants and former assistants. He taught more than 3,000 undergraduates, had more than 100 assistants, and supervised 41 doctoral students. He attracted excellent students, inspired them, and kept them interconnected.

In addition to being a major force in Swiss building code groups, he chaired major technical committees in both American and European organizations. His crowning organizational achievement was his presidency of the International Association for Bridge and Structural Engineering (IABSE) from 1977 to 1985. Under his leadership, the organization greatly increased the number and improved the quality of its conferences, publications, and committees. Although Bruno was a man of great culture and knowledge, he was always easy to approach, ready for a discussion, and able to put people at ease with a story or joke.

He received wide recognition for his many contributions to structural engineering, including election to membership in NAE, the Swiss Academy of Technical Sciences, and similar Spanish, German, and Serbian Academies. He received honorary degrees from Stuttgart and Glasgow universities, was an Honorary Member of both the American Concrete Institute and the American Society of Civil Engineers, and was awarded the French Prix Albert Caquot Medal and the Danish Ostenfeld Gold Medal. IABSE presented him with the International Award of Merit in Structural Engineering for his lifelong contributions. By the time he retired in 1990, he had developed his institution into one of the leading centers in the world for research on structural concrete, with modern laboratories and an excellent team that continued his work.

That gave him more pleasure, he said, than his closet full of awards and diplomas.

Above all, Bruno Thürlimann was a person of great wisdom, who recognized the importance of sustainability in engineering early on. In a major essay in 1980, based in part on a previous study by one of his former students, he called attention to the total energy requirements for producing a wide range of building materials. Comparing the energy requirements for five-meter span beams of various materials but equal strength, the study had shown as much as a 260 percent difference between the requirements for producing a steel beam and a prestressed concrete beam.

In a challenging essay, "Technology and Man," in 1979, he called on engineers to let their technical and scientific work be guided by intelligence, reason, and humility. In his characteristic way, he foresaw that, despite how far technology had taken us, "even at the end of the 20th century, we have limited knowledge and are still bound by many errors." In his lectures, he brilliantly separated pure mathematical derivations from the fudging of factors to fit experimental boundary conditions. He believed that "nature, as well as the human spirit, follows the path of a steady evolution," and he cautioned that science does not protect against foolishness. He urged his listeners to always inform the public of the state of "our ignorance in making our pronouncements."

After his retirement, Bruno enjoyed his home life, his supportive wife, Susi, and his family. He maintained informal contact with his vast network of former students, colleagues, and international body of friends from his IABSE days.

On July 29, 2008, Bruno Thürlimann died of sudden heart failure while swimming in the lake of Zurich. He is survived by his wife, Susi, two sons, one daughter, and four grandchildren.

RONG-YU WAN

1932–2009

Elected in 2000

"For accomplishments in metallurgical research and industrial practice, and for teaching, supervising, and inspiring students, researchers, and industrial colleagues."

BY JAMES A. BRIERLEY AND CORALE L. BRIERLEY

RONG-YU WAN, a world-class metallurgical engineer, died September 22, 2009.

Dr. Wan received her B.S. in chemical engineering in 1952 from Chiao Tung University in Shanghai, China. After graduation she became fully involved in China's industrial reconstruction. She was a process engineer with Engineering for Nonferrous Metallurgical Industries from 1953 to 1957. From 1958 to 1964 she was project manager at the Beijing Mineral Processing Research Institute. She then served from 1964 to 1980 at the Beijing General Research Institute of Mining and Metallurgy as research scientist, supervisor, and chief of metallurgy.

In 1980, at the age of 48, Dr. Wan made a courageous decision to temporarily leave her family and immigrate to the United States to further her career in metallurgy through graduate studies with Professor J. D. Miller (NAE) at the University of Utah. She received her Ph.D. in metallurgy and metallurgical engineering in 1984. Her family, husband Ke-Zhong Wang and son Joseph, then joined her in Salt Lake City to begin a new life in the United States, where she served as a research associate professor at the University of Utah until 1987.

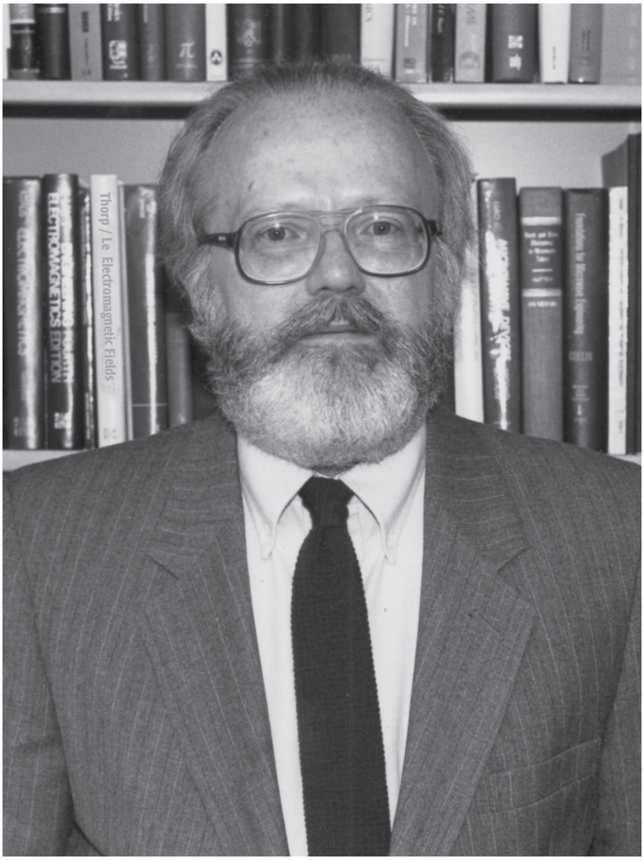
In 1987 Dr. Wan moved to the business sector when she joined Newmont Mining Corporation's metallurgical services research and development team. Later she was promoted to chief research scientist of hydrometallurgy, retiring in 2001. Newmont Mining Corporation's Chairman and CEO Wayne Murdy awarded her the Chairman's Award "in recognition of lifetime achievements in the areas of process development, hydrometallurgy, pyrometallurgy and operations support through her tireless dedication and loyalty." Throughout her business career she demonstrated her dedication to education by advising and offering encouragement to many students pursuing their education goals. After her retirement she continued to work with the staff of Newmont Metallurgical Services as a consultant, mentoring colleagues and advising on research projects until shortly before her death in 2009.

Dr. Wan was elected to the National Academy of Engineering in 2000. Her citation reads "for accomplishments in metallurgical research and industrial practice and for teaching, supervising, and inspiring students, researchers, and industrial colleagues," reflecting her dedication to research and education. Dr. Wan served the NAE through participation on the Bernard Gordon Prize Committee (2004–2006), the Earth Resources Engineering Peer Committee (2004–2007), and the Committee on Membership (2007–2009). She also participated on the National Research Council's Committee on Technologies for the Mining Industries (2000–2001) and the Committee on Earth Resources (2004–2006).

Rong-Yu Wan was a generous contributor to mining engineering through her participation in professional committees. These contributions were recognized in 2001 by the Society for Mining, Metallurgy, and Exploration's Antoine M. Gaudin Award, one of the society's most prestigious awards. She was cited "for her tireless efforts in the development of new processes for the treatment of refractory gold ores through the application of mineral processing fundamentals to plant testing." This award reflected Dr. Wan's work in process development testing of critical design factors for Newmont Mining Corporation's 10,000-ton daily roaster operation in

Carlin, Nevada, and the development of thiosulfate leaching technology for preg-robbing carbonaceous ores and as an alternative lixiviant to cyanide. Dr. Wan's efforts resulted in the granting of six U.S. patents authored by her on gold leaching and gold recovery processes.

Dr. Wan was truly a kind and respectful person in both her professional and private lives. Her colleagues will never forget her compassion, pleasant personality, excitement for researching new processes, and boundless enthusiasm and energy. She taught all of us valuable life lessons through her dedication and commitment to excellence and her enduring passion for science and engineering. Rong-Yu never dwelled on obstacles she faced in her life and career, always conquering challenges to excel in personal and professional development. Dr. Wan is survived by husband Ke-Zhong Wang, son Joseph Wang and his wife Flora, and grandchildren Adeline and Andrew.



CHARLES M. WOLFE

1935–2008

Elected in 1991

"For fundamental achievements in the synthesis and characterization of ultrapure III-V semiconductors."

BY ABE L. CROSS
SUBMITTED BY THE NAE HOME SECRETARY

CHARLES M. WOLFE, professor emeritus of electrical engineering at Washington University in St. Louis, passed away on October 18, 2008, at the age of 72.

Charles Wolfe was born on December 21, 1935, in Morgantown, West Virginia, to parents Slidell Brown Wolfe and Mae Louise Wolfe. He received his bachelor of science and master of science degrees in electrical engineering from West Virginia University in 1961 and 1962. In 1965 he received his Ph.D. from the University of Illinois. A veteran of the U.S. Marine Corps, he served from 1955 to 1958.

Dr. Wolfe was a staff member at the Massachusetts Institute of Technology's Lincoln Laboratory from 1965 to 1975, when he joined the faculty at Washington University in St. Louis. He was appointed as the Samuel C. Sachs Professor of Electrical Engineering in 1982 and served in that capacity until 1990. He became professor emeritus in 1998.

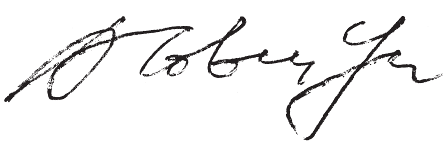
For his contributions to the development of high-purity gallium arsenide for microwave and optical device applications, Dr. Wolfe received an Electronics Division Award from the Electrochemical Society in 1978. Also in 1978 he was elected a fellow in the Institute for Electrical and Electronics Engineers (IEEE).

Charles Wolfe and Gregory Stillman were joint recipients of the prestigious IEEE Jack A. Morton Award in 1990 for the growth and characterization of ultra-high-purity gallium arsenide and related compounds. Along with Gregory Stillman and Nick Holonyak, Dr. Wolfe published *Physical Properties of Semiconductors* (Prentice Hall, 1989.) The book has since been cited in numerous publications.

For his fundamental achievements in the synthesis and characterization of ultrapure III-V semiconductors, Dr. Wolfe was elected a member of the National Academy of Engineering in 1991. He was honored specifically for his work in developing and purifying gallium arsenide compounds for their use in high-speed analog and digital integrated circuits for a variety of electronic applications.

The University of Illinois Department of Electrical and Computer Engineering honored Dr. Wolfe with a Distinguished Alumni Award in 1993. The award recognizes graduates who have made professional and technical contributions that bring distinction to themselves, the department, and the university.

Dr. Wolfe's love for academia and the educational process, displayed by his endless drive to learn and to answer the unanswered questions of our physical world, was balanced in his life by his deep passion for the "romantic arts" of music, painting, poetry, love, and family. Ever charismatic, Charlie, as he was affectionately known, will always be remembered by those who knew and loved him as a unique-minded, fun-loving, dry-witted, mischievous, and passionate soul, who lived his life on his own terms. He is survived by his children, David M. Wolfe and Diana Michele Foster, and his grandchildren, Brandi Foster, Jeremy Foster, Chloe Wolfe, and Charles Wolfe.



A. TOBEY YU

1921–2009

Elected in 1989

"For pioneering contributions to materials handling, transportation, and processing."

BY RAJA V. RAMANI

A. TOBEY YU, co-founder of ORBA Corporation and a pioneer in the development of bulk materials handling systems, died on April 8, 2009, at the age of 88 in Haiku, Maui. He is survived by his wife Natalie, son Leonard and wife Roberta Beatty, daughter Pamela and husband John Bannister, and four grandchildren.

The concept behind ORBA was hatched in the foothills of the Andes in South America. Tobey first visited the Cia Minera Sante Fe in Chile in 1957 as the chief engineer for Hewitt Robins, Inc., to build its materials handling system. Later he became the technical director of Cia Minera Sante Fe's iron ore operations, which shipped high-grade ore to virtually every steel mill in the world. The company had to solve all the problems that arose in mining, processing, and transhipment of facilities associated with the bulk materials. Tobey concluded that a company dedicated to designing, building, operating, and troubleshooting bulk materials handling systems was needed.

ORBA's quick growth in a relatively short time since its founding in 1972 to become a world leader in bulk materials transportation and its record compilation of several notable engineering firsts are testimony to Tobey's enormous contribution to the mining and materials handling industries.

Tobey and ORBA are credited with turning "the Great Lakes into a modern, efficient ore / coal shipping waterway, humming with automated docks and a fleet of giant self-unloaders."

For his pioneering contributions to materials handling, transportation, and processing, Tobey was elected to the National Academy of Engineering in 1989. In 1998 he became the 145th inductee into the National Mining Hall of Fame in Leadville, Colorado.

Tobey was born January 6, 1921, in Jiangxi province, China. Orphaned when he was very young, Tobey was raised in China by American Methodist missionaries whose dedication left a deep impression on him. He was to reflect that, "if everyone contributed just a little bit, it would be a much better world." Toward the end of World War II, on the basis of the results of a public examination in China, which over 5,000 students took, Tobey was one of 700 selected to study in the United States, arriving in Boston in February 1945. Prior to coming to the United States, Tobey had earned his bachelor's degree in civil engineering from Central University in Chungking in 1943. He completed his master's degree in aeronautical engineering from the Massachusetts Institute of Technology in 1946 before attending Lehigh University for his Ph.D. in civil engineering, which he earned in 1949 while working for Bethlehem Steel as an engineer.

It was very disappointing to Tobey that, due to circumstances at the end of the war, he could not return to China. It would appear that nothing in life was easy for Tobey, but turning adversity to advantage was one of his greatest characteristics. Disappointed as he was, he moved to New York City to teach at New York University (NYU) and Cooper Union. That was the start of a remarkable career that saw Tobey make his mark as an educator, an engineer, a manager, and a chief executive. Tobey's professional life is a continuous tale of defying tradition and conquering new frontiers, from the Atacama Desert in Chile to the Great Lakes in the United States to developing an efficient delivery chain for bulk materials.

While in New York, he met his wife, the former Natalie Kwok, who was born in Shanghai and had majored in arts in college. They were married in 1951. Their daughter, Pamela, was born in 1952 and their son, Leonard, in 1955. Natalie was busy taking care of the home front as Tobey traveled extensively to remote corners of the world, where mining and bulk materials handling were synonymous activities. Among the six primary sources for his inspiration, energy, and tenacity, according to Tobey, the sixth and most important of all was "the sacrifices endured by his family over the long years."

While teaching at NYU, the drawings of Hewitt-Robins traveling stackers and traveling shiploaders for a manganese mining operation revealed to him the potential of integrating his structural and mechanical training for enhancements in materials handling systems. Tobey joined Hewitt-Robins, which "did a lot of work for the mining and the steel industry," as an engineer in 1951. Much appreciated and recognized for his imagination, Tobey was quickly promoted successively to chief design engineer, director of systems engineering, and vice president of operations. Along the way, Tobey obtained an M.B.A. from Columbia University (1972) and was licensed as a professional engineer in Alabama, Florida, Minnesota, New Jersey, New York, and Wisconsin.

Along with two other partners, Tobey formed ORBA in 1972—a firm dedicated to cost-effective integrated delivery chains of bulk materials, with the letter O standing for ore, R for raw materials, B for bulk cargo, and A for anything to be moved. The firm grew from its three founders to a staff of 250 professionals in three years.

Over 100 major projects worldwide, involving virtually all kinds of bulk materials, such as coal, iron ore, phosphate, potash, and copper concentrate, were successfully designed, built, or operated under Tobey's direction. He was at the forefront of the revolution in designing equipment and systems of capacities and capabilities never before attempted. The Superior Midwest Energy Terminal in Superior, Wisconsin, which was completed in 1976, became the gateway for transportation of low-sulfur western coal. It won the 1977 Outstanding Civil Engineering Achievement Award from the American Society of Civil Engineers. ORBA went on to design and build several other award-winning materials handling facilities, including the Two Harbors Taconite Terminal and the Lorain Pellet Terminal, which won Outstanding Engineering Achievements of the Year awards from the National Society of Professional Engineers.

Tobey achieved many notable engineering firsts, including the first modularized automated truck-to-train transfer station and the first modularized dry magnetite beneficiation plant. During the period 1978 to 1986, at the invitation of the Chinese government, he lectured in China on materials handling systems for several science, engineering, and technology groups. Tobey retired as ORBA's chairman in 1987. Even in retirement, he continued to be active in professional and technical activities, only scaling back to a six-day work week from a seven-day one.

Tobey's remarkable achievements were recognized by several peer groups in diverse fields of engineering. In 1977 the Chinese Institute of Engineers (CIE) honored him with the CIE-USA Achievement Award for his contributions to the design and construction of ship-barge loading systems. In 1986 Tobey became the president of the Society of Mining Engineers. In 1987 he was named a distinguished member of the society in appreciation of outstanding service to the minerals industry. In 1988 he was bestowed the Distinguished Achievement Award of the American Society of Mechanical Engineers for his outstanding achievements in materials handling engineering. Tobey's significant, innovative, and valuable contributions to the technology of transportation and handling of materials were cited when he was awarded the American Institute of Mining, Metallurgical and Petroleum Engineers (AIME) Robert H. Richards Award in 1989. He was AIME's Henry Krumb Lecturer in 1990.

Tobey was one of the most prolific authors in the mining, mechanical, and materials handling fields, with over 200 publications in leading journals and handbooks. He wrote a wonderful small book—*Utmost Simplicity: My Life and Its Lessons* (Flying Rabbit Press, 2007)—which is a veritable storehouse of pearls of wisdom hidden among numerous anecdotes of his interesting life experiences. Here is a quote on his philosophy of working with people and building teams: "There is no such thing as a perfect person. But there is such a thing as a superb team. If you put good people together, they can compensate for each other's shortcomings, they can expand, grow, enlarge to the extent—you almost feel there is no limit to it." This is the lasting legacy of a simple, humble, noble man.

APPENDIX

Members	Elected	Born	Deceased
Paul A. Beck	1981	February 5, 1908	March 20, 1997
Gary L. Borman	1990	March 15, 1932	January 17, 2005
Joseph E. Burke	1976	September 1, 1914	February 29, 2000
Spencer H. Bush	1970	April 4, 1920	October 2, 2005
L. G. (Gary) Byrd	1987	May 6, 1923	March 20, 2009
Benjamin A. Cosgrove	1992	December 27, 1926	September 8, 2006
Alan G. Davenport	1987	September 19, 1923	July 19, 2009
H. Ted Davis	1988	August 2, 1937	May 17, 2009
Victor Froilano Bachmann De Mello	1980	May 14, 1926	January 1, 2009
Michael L. Dertouzos	1990	November 5, 1936	August 27, 2001
Coleman Dupont Donaldson	1979	September 22, 1922	August 7, 2009
Jackson Leland Durkee	1995	September 20, 1922	June 14, 2007
Gunnar Fant	1982	October 8, 1919	June 6, 2009
Irene K. Fischer	1979	July 27, 1907	October 22, 2009
Patrick F. Flynn	1995	November 14, 1937	August 19, 2008
John W. Fondahl	1993	November 4, 1924	September 13, 2008
Gerard F. Fox	1976	January 3, 1923	December 12, 2008
John L. Gidley	1994	December 30, 1924	March 30, 2009
John J. Gilman	1975	December 22, 1925	September 10, 2009
Earl E. Gossard	1990	January 8, 1923	January 27, 2009
Serge Gratch	1983	May 2, 1921	December 4, 2007
William A. Griffith	1998	March 28, 1922	April 30, 2009
William T. Hamilton	1978	July 26, 1917	February 16, 2002
Howard L. Hartman	1994	August 7, 1924	January 12, 2002
Martin C. Hemsworth	1980	June 3, 1918	March 28, 2009
Kenneth J. Ives	2003	November 29, 1926	September 8, 2009
Joseph M. Juran	1988	December 24, 1904	February 28, 2008
Roger P. Kambour	1992	April 1, 1932	December 20, 2008
Raphael Katzen	1996	July 28, 1915	July 12, 2009
Ken Kennedy	1990	August 12, 1945	February 7, 2007
Jack D. Kuehler	1984	August 29, 1932	December 20, 2008
Ralph Landau	1972	May 19, 1916	April 5, 2004
Kurt H. Lange	1988	December 13, 1919	August 1, 2009
Craig Marks	1985	October 9, 1929	July 20, 2009
Albert R. Marschall	1990	May 5, 1921	November 18, 2008
Thomas L. Martin, Jr.	1971	September 26, 1921	October 8, 2009
David Middleton	1998	April 19, 1920	November 16, 2008
Joseph Miller	1991	April 3, 1937	July 5, 2007
William W. Moore	1978	January 24, 1912	October 23, 2002
Morris Muskat	1983	April 21, 2006	June 20, 1998

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Members	Elected	Born	Deceased
Phillip S. Myers	1973	May 8, 1916	October 18, 2006
Robert E. Newnham	1989	March 28, 1929	April 16, 2009
James Y. Oldshue	1980	April 18, 1925	January 16, 2007
Ralph B. Peck	1965	June 23, 1912	February 18, 2008
Theodore H. H. Pian	1988	January 18, 1919	June 20, 2009
William Hayward Pickering	1964	December 24, 1910	March 15, 2004
Nathan E. Promisel	1978	June 20, 1908	December 15, 2005
Robert O. Reid	1985	August 24, 1921	January 23, 2009
Allen F. Rhodes	1985	October 3, 1924	August 18, 2007
Jacob T. Schwartz	2000	January 9, 1930	March 2, 2009
William Rees Sears	1968	March 1, 1913	October 12, 2002
Franklin F. Snyder	1985	November 11, 1910	March 13, 2008
George E. Solomon	1967	July 14, 1925	April 25, 2005
Morgan Sparks	1973	July 6, 1916	May 3, 2008
John E. Steiner	1978	November 7, 1917	July 29, 2003
Olin J. Stephens II	1994	April 13, 1908	September 13, 2008
Thomas G. Stockham, Jr.	1998	December 22, 1933	January 6, 2004
Bruno Thürlimann	1978	February 6, 1923	July 29, 2008
Rong-Yu Wan	2000	January 12, 1932	September 22, 2009
Charles M. Wolfe	1991	December 21, 1935	October 18, 2008
A. Tobey Yu	1989	January 6, 1921	April 8, 2009