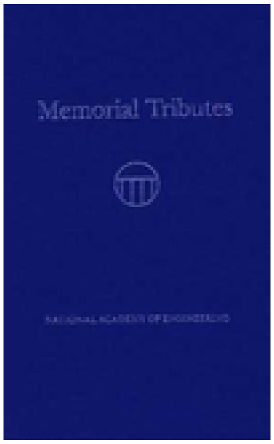

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Memorial Tributes

National Academy of Engineering

Memorial Tributes

Volume 4

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Contents

Foreword

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

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

ALEXANDER H. FLAX

Home Secretary

Memorial Tributes

National Academy of Engineering

William C. Ackermann

1913-1988

Written by William J. Hall,
W. Hall C. Maxwell, and Glenn E. Stout
Submitted by William J. Hall

William C. Ackermann, former chief of the Illinois State Water Survey and emeritus professor of civil engineering at the University of Illinois at Urbana-Champaign, died of lung cancer on June 9, 1988, in Urbana, Illinois, following several months of declining health.

Bill Ackermann was born on October 7, 1913, in Sheboygan, Wisconsin, a son of William and Frances E. Shermer Ackermann. He married Margaret Adele Koepsell on May 6, 1942, in Sheboygan. He attended Lawrence College (now Lawrence University) in Appleton, Wisconsin, before going on to complete his undergraduate education at the University of Wisconsin at Madison, from which he graduated in 1935 with a B.S. (honors) in civil engineering.

Upon graduating he spent a short time with Kimberly Clark Corporation in Neenah, Wisconsin, and then began his professional career as a water resources engineer with the Tennessee Valley Authority in Knoxville, Tennessee. He worked in the Water Control Planning Department as a river forecaster from 1935 to 1941, and then headed the Hydrology Section from 1942 to 1954. In 1954 he moved to the U.S. Department of Agriculture's Agricultural Research Service in Beltsville, Maryland, where he headed the Watershed Hydrology Section. Two years later he was appointed chief of the Illinois State Water Survey. In 1958 he was given a joint appointment as professor of civil engineering at the University of Illinois in Urbana-Champaign. It was during his years in Illinois that Professor Ackermann made his most valuable contributions to the field of water resources.

In 1963 he accepted a one-year special assignment on the White House staff in Washington, D.C. as technical assistant in the Office of Science and Technology, Executive Office of the President, where he chaired the Committee on Water Resources Research. He strongly advocated the establishment of water resources institutes in fifty states, and this was enacted by Congress in 1964. He continued to serve the Executive Office of the President in various capacities from 1964 to 1984, and was vice-chairman of the Acid Rain Peer Review Panel. He was proud of his service in the White House and was seldom seen without the PT 109 tie clip given to him by President Kennedy.

In 1967 he directed the preparation of Illinois' first comprehensive water plan. This guided water management decisions in Illinois for twenty-three years until about 1980, when he was asked to direct the preparation of a new plan. He served as the executive director of the Illinois State Water Plan for the state of Illinois' Division of Water Resources until 1987.

Bill Ackermann was elected to the National Academy of Engineering (NAE) in 1967 and served on the NAE Council from 1972 to 1975. He was particularly known for his willingness to serve and did so on many of the Academy's advisory boards and committees including, starting in 1970, his chairmanship of the Academy's Committee on Engineering Aspects of Environmental Quality, and from 1980 to 1982, the National Research Council (NRC) Water Resources Research Review Committee that evaluated the U.S. water resources program. In addition he was a member of the Environmental Studies Board, a joint committee of the National Academy of Sciences-National Academy of Engineering. He served on the Executive Committee and Commission of the NRC Commission on Natural Resources from 1973 to 1978, and was president of the U.S. National Committee for the International Union of Geodesy and Geophysics.

His major consulting activities included consultation for the Commonwealth of Puerto Rico in 1970, the Upper Mississippi River Basin Commission from 1979 to 1981, and the Department of Commerce's Office of Sea Grant Programs from 1978 to 1985.

Bill Ackermann was honored many times during his fifty-year career. These honors include his membership in the National Academy of Engineering, the Laureate Medal of the Lincoln Academy of Illinois, the American Society of Civil Engineers' Collingwood Prize, the American Geophysical Union's Robert E. Horton Medal (cited for "expertise and outstanding leadership in research, planning, and management of water resources"), the Soviet Medal for Geophysics, the American Water Works Association's Fuller Award, and the American Water Resources Association's Icko Iben Award. He was also twice awarded honorary doctor of science degrees: one in 1970 from Northwestern University in Evanston, Illinois, and a second in 1971 from Southern Illinois University in Carbondale, Illinois. At the time of his death he was to be the first recipient of the American Water Resources Association's William C. Ackermann Award for Planning and Management in Water Resources.

Besides his long service as chief of the Illinois State Water Survey, other positions of leadership that he assumed over the years included the presidency of the American Geophysical Union (AGU) from 1966 to 1968, AGU's Section of Hydrology from 1962 to 1964, the International Association of Scientific Hydrology in 1971, the Committee on Water Research of the International Council of Scientific Unions, and vice-presidency of the International Union of Geodesy and Geophysics. His leadership roles in the American Society of Civil Engineers included chairmanship of the Hydrology Committee in 1953, of the Hydraulics Division from 1966 to 1967, of the National Water Policy Committee from 1969 to 1970, and of the National Energy Policy Committee from

1973 to 1975. He was a member of the society's board of direction from 1971 to 1974.

Bill Ackermann loved teaching, and when he retired from the Illinois State Water Survey in 1979 he became fully involved with education. In 1980 he was appointed adjunct professor of civil engineering at the University of Illinois in Urbana-Champaign, and in 1985, when he retired from that position, was appointed emeritus professor.

Bill Ackermann's life of service was not confined to engineering or scientific matters, nor was it solely at the state, national, or international level. He was a member of the First Presbyterian Church in Champaign, Illinois, where he was a longtime elder. He was a member of the Champaign Kiwanis Club.

He is survived by his wife, Margaret; his sons William C. Ackermann of Champaign, Illinois, and Arthur J. Ackermann of Kirkwood, Missouri; his daughter, Mrs. David (Nancy) Price of Summerville, South Carolina; and seven grandchildren.

Those of us who were privileged to know Bill Ackermann and to work closely with him during his years here in Illinois feel a great sense of loss at his passing. We miss his wise counsel and advice, and his willing service whenever called upon.

Maurice Apstein

1910-1987

By Jacob Rabinow

Maurice Apstein, former associate technical director of the Army's Harry Diamond Laboratories and a professor of the George Washington University's Department of Engineering Administration, died of a heart attack on March 16, 1987.

Maurice Apstein was born on May 5, 1910, in Bridgeport, Connecticut. He received his early education in the public schools of Bridgeport and New York City. He attended the City College of New York where he received his B.S. in electrical engineering in 1932. He did some graduate work at the New York University, and later, after moving to Washington, D.C., he earned a master's degree in engineering administration from the George Washington University in 1959. In 1963 he received the Ph.D. in research administration from the American University.

Mr. Apstein entered the electronics industry early in his career. Always having been interested in this field, he was a ham radio operator for most of his life.

In 1932 he joined the Simplex Electric Company of New York as a design engineer on public address equipment, and in 1935 he joined the Morlen Electric Company as a senior engineer. The Morlen Electric Company was involved in the design and construction of high-power audio equipment. Among these was the system used at the Paris

International Exposition of 1937. He became chief engineer of Morlen in 1938.

From 1940 to 1945 Maurice Apstein was connected with the Board of Education of New York City, serving successively as teacher of radio communication, chairman of the Radio Department, and assistant to the Board of Examiners.

During this period, Dr. Apstein also served as a consulting engineer to the Cardwell Manufacturing Corporation, an important manufacturer of component equipment and total systems of radio transmitters and test equipment.

In 1945 Maurice Apstein joined Cardwell Manufacturing Corporation as chief engineer and was a major actor in the company's large efforts during World II. His fields of work included such items as high-frequency meters, automatic calibration equipment, signal generators, auto-tune transmitters and receivers, and radio direction finders.

In 1949 at the urging of friends in Washington, he joined the staff of one of the ordnance divisions of the National Bureau of Standards (NBS) as a supervising electronics scientist.

As is well known now, the ordnance laboratories of NBS were the major development organization of radio proximity fuzes, particularly for nonrotating projectiles, such as bombs, rockets, and guided missiles.

Here he showed early his great expertise in electronic engineering by inventing a new electric bomb fuzing system, and many other devices and system for electronic ordnance.

For his work at the NBS, Maurice Apstein received the U.S. Department of Commerce's Exceptional Service Award. In 1952 he was promoted to the post of assistant chief of the Electro-mechanical Ordnance Division.

When the three ordnance divisions were separated from NBS in 1953 and were formed into the Diamond Ordnance Fuze Laboratories, Dr. Apstein chose to remain with that group and became chief of the electro-mechanical laboratory. Here he supervised the general design and made many personal technical contributions to the safety and arming systems of many of our most important weapons.

From 1955 on, Maurice Apstein served in progressively more important posts such as chief of several main divisions of the Harry Diamond Labs. In 1957 he was associate director for research and, finally, in 1960 he became the associate technical director of this institution. He also served as engineering science member and chairman of the U.S. Army Research Council.

For his contributions to the work in ordnance, in addition to the gold medal from the U.S. Department of Commerce, Dr. Apstein received many honors. In 1960 he was awarded the Secretary of the U.S. Army Research Study Fellowship. The result of the study was a very important report on the proper balance between in-house and contract efforts on research and development by government laboratories. Dr. Apstein was a firm believer that a major share of research and development needed by the government should be done in government laboratories, and that if this is not done, the government scientists and engineers quickly lose their expertise, both because they are no longer doing the development themselves and because they have no time for actual engineering work while managing the outside contracts.

Maurice Apstein retired from government work in 1974 and for the next three years served as a research professor of engineering administration at the George Washington University.

As recognition of Dr. Apstein's contribution to the field of electronic engineering, he was raised to the ranks of fellow of the Washington Academy of Sciences in 1958, and fellow of the Institute of Electrical and Electronics Engineers (IEEE) in 1959. The IEEE awarded Dr. Apstein the Harry Diamond Memorial Award in 1969 "For contributions to ordnance electronics and inspiring leadership in the work of government laboratories."

Among many other honors, he also received the U.S.

Department of the Army Decoration for Exceptional Civilian Service in 1973 "For exceptionally meritorious performance of duties and major contributions to defense systems from 1949 to August 1972."

Maurice Apstein was also a member of the Washington Philosophical Society, the American Association for the Advancement of Science, and the Cosmos Club.

In addition to his in-house work for the Harry Diamond Labs and the George Washington University, Dr. Apstein served as a member of literally dozens of committees and delivered many lectures. These latter were particularly concerned with the management aspects of research and development. Space does not permit the detailed listing of the papers and reports authored by Maurice Apstein. He received sixteen U.S. patents and there were a few more pending at the time of his death.

If we were to describe the work and interests of Maurice Apstein's life, we can state, briefly, that here was a brilliant engineer who was equally interested and proficient as a superb technician and as a superb manager.


William J. Bailey

William J. Bailey

1921-1989

By James Economy

Professor William. Bailey died on December 17, 1989, after collapsing at the opening reception of the 1989 International Chemical Congress of Pacific Basin Societies in Honolulu.

During his career Dr. Bailey made a number of major contributions to the field of polymer science and technology. Professor Bailey invented a new class of monomers that expand during polymerization, resulting in high-strength adhesives, strain-free composites, and strongly adhering coatings. These monomers, which are now commercially available, solve the basic problem of shrinkage during curing, a phenomenon that acts to greatly weaken the bond at the interface. He discovered and developed new methodologies for preparing completely biodegradable polyethylene, polystyrene, and polyamides. These processes are now actively being evaluated in many industrial laboratories. He developed a general procedure for free radical-ring opening polymerization that uniquely incorporates hydrophilic units in the backbone, thus providing a general route to preparation of biocompatible addition polymers. He carried out pioneering studies on the pyrolysis of organic and polymeric materials leading to (1) a general preparative route for sensitive olefins by rapid heating of esters and (2) the first interpretation of thermal degradation of vinyl polymers via a unique cyclic mechanism. He also prepared and characterized the first complete ladder polymer and thus laid the groundwork for the massive effort that followed on the development of thermally stable, ladder polymers.

Professor Bailey was very active in the American Chemical Society (ACS) and was a member of the ACS board from 1973 to 1982. He was chairman of the board in 1979 and 1981 and president of ACS in 1975. He was an ACS member since 1945, chairman of the ACS Washington, D.C. Section in 1961, and a councilor for that section for many years. He was active in the ACS Division of Polymer Chemistry, which he chaired in 1968, and served as a member of the ACS Division of Professional Relations.

His contributions were recognized by a number of major awards from the American Chemical Society including the ACS Award in Polymer Chemistry in 1977, the ACS Award in Applied Polymer Science in 1986, and the Henry Hill Award of the ACS Division of Professional Relations in 1988. He was also the recipient of the Fatty Acid Producers Award in 1955, an Outstanding Achievement Award from the University of Minnesota in 1976, the Hillebrand Prize from Washington's Chemical Society in 1984, and a Distinguished Polymer Scientist Award from the ACS Polymer Division in 1985. He was invited to present honorary lectures at a number of universities and organizations.

Dr. Bailey was a native of East Grand Forks, Minnesota. He earned a B.S. in chemistry at the University of Minnesota in 1943 and a Ph.D. in organic chemistry at University of Illinois in 1946 with Professor C. S. Marvel. After a year as a post-doctoral fellow at Massachusetts Institute of Technology with Professor Cope, he joined the faculty of Wayne State University in Detroit. He was an associate professor of organic chemistry there when he left in 1951 to join the Maryland faculty.

He is survived by his wife, the former Mary Caroline Worsham, a son, two daughters, and a brother. Former students of Bailey planned a symposium in his memory at the ACS national meeting August 1990 in Washington, D.C., to be followed by a reception for colleagues and friends. A scholarship fund has been established in his name at the University of Maryland.

On a more personal note Professor Bailey was considered one of the two or three dominant figures in the field of polymer synthesis during the past forty years. He was an outstanding human being, open and friendly, willing to take time with anyone who wished to chat and especially to provide help, advice, and encouragement. There is little question that he will be missed by his former students and associates not only as a colleague and mentor but above all as a dear and close friend.

Harold M. Barlow

Harold E. M. Barlow

1899-1989

By Edward C. Jordan

Harold E. M. Barlow, an internationally known figure in radio wave propagation and microwave engineering, died April 20, 1989, at age eighty-nine.

At the time of his death, Dr. Barlow was professor and dean emeritus in the Faculty of Engineering, University College, University of London, where he had served as head of the Department of Electrical and Electronics Engineering for eighteen years.

Harold Barlow was born November 15, 1899, in London, England, and educated at University College, London, receiving a B.Sc. degree in engineering in 1921 and a Ph.D. in science in 1924. He was made a fellow of City and Guilds College, London, and was awarded an honorary doctor of science degree by Heriot Watt University, Edinburgh, and an honorary doctor of engineering degree by Sheffield University, Sheffield.

Dr. Barlow played a leading part in the wartime development of radar. In 1939 he was seconded to work on radar development and worked in the Telecommunications Research Establishment from 1943 to 1945. He then became superintendent of the Radio Department of the Royal Aircraft Establishment in Farnborough until 1950.

He served with distinction on many governmental advisory boards where his broad background in both science and engineering proved invaluable. As a member of the Advisory Council of the Ministry of Technology British Calibration Service and chairman of its High Frequency Measurements Committee, he played an important role in the establishment of international electrical standards of measurement.

Professor Barlow was a man of broad interests who achieved outstanding success in all of them. As a research engineer he became the foremost microwave authority in the United Kingdom. He developed the theory and application of surface waves and led in their application to a wide range of problems such as high-speed railways.

As a professional engineer he was the inventor of a number of important microwave devices including the Hall-effect microwave watt meter, which has become a standard in many laboratories around the world.

As an educator at University College he developed the leading school of electrical engineering in England. He revitalized the undergraduate course with greater emphasis on fundamentals, introduced a successful M.Sc. course in microwave engineering, and developed and led a strong research school in microwaves.

Dr. Barlow became known internationally through his many publications (more than one hundred) and through his association with URSI, the International Union of Radio Science. In URSI he became chairman of the United Kingdom National Committee and chairman of International Commission VI (Radio Waves and Circuits). He was also chairman of the (international) Electromagnetic Theory Symposium. From URSI he received the coveted Howard Dellinger Gold Medal, the highest award in its field, for "his contributions to the theory and practice of radio wave propagation and particularly the study of guided waves." From the Institute of Electrical and Electronics Engineers he received the 1975 Mervin J. Kelley Award for "outstanding work in the measurement and properties of radio frequency waves, and their application to telecommunications."

Dr. Barlow received many other honors and awards beginning with the Kelvin Premium of the Institution of Electrical Engineers (London) in 1930 and including the Faraday Medal (1957), a fellowship in the Royal Society of London (1958), and finally the Royal Medal of the Royal Society in 1988. After his retirement from the Pender chair in 1967, he continued his research in the laboratory and his writings on guided microwaves and wave propagation in optical fibers. He served as the McKay Professor of Electrical Engineering at the University of California, Berkeley, in 1957 and was elected a foreign associate of the National Academy of Engineering in 1979.

Professor Barlow had a fine personality and a delightful sense of humor. Despite his success he remained modest and once remarked that he felt so fortunate to be associated with such talented junior colleagues. These men were attracted by his warm personality and his generosity in sharing credit with others. Throughout his career he was supported by his charming wife Janet. International visitors recall with pleasure being entertained in the Barlow home and garden. Mrs. Barlow, three sons, and a daughter survive.

Bernard P. Bellport

1907-1987

By J. Donovan Jacobs

Bernard Philip Bellport had been a member of the National Academy of Engineering (NAE) for seventeen years at the time of this death on October 3, 1987. His participation in development of American water resources is an important chapter in the engineering saga "Reclaiming the West." Here are some memories of the man, as recalled by friends who knew him well. Because he always preferred to be addressed simply as "Barney", that habit will not here be broken.

Barney entered this world May 25, 1907, in the small town of LaCrosse, Kansas. His father, also Bernard P., passed away while Barney was an infant. When the child became eight, his mother, Louise, packed their belongings and with her son traveled westward to a new home in Merced, California.

The lad attended grammar school in Merced and high school in Palo Alto. After high school, Barney matriculated in Polytechnic College of Engineering in Oakland. He graduated from Polytechnic in 1927 with a B.S. in mining engineering. Shortly thereafter he was hired by St. Joseph Lead Company as assistant engineer-geologist. He did underground exploration work for them until the mines succumbed to the great depression in 1931. His mining career had been brief but productive. He had learned the practicalities of underground operations and had acquired a colorful vocabulary.

Disregarding the depression, Barney succeeded in selling himself as a civil engineer to Phoenix Utility Company that was laying natural gas lines in Butte and Helena for Montana Power Company. When the pipe lines were completed, he rustled a field engineering job with Montana Highway Department. He worked for the state until 1935 when a depleted treasury forced the department to cancel dozens of contracts and lay off hundreds of manual and technical employees, including Engineer Bellport.

During the following months, Barney learned a lot about hardship caused by economic collapse. Further employment prospects in Montana were bleak, so he packed his wife and baby daughter into the old car and headed back to California where, at least, winter heating bills were lower. Home again, he picked up whatever odd jobs came his way, and took a government civil service examination for junior engineer. Early in 1936 Barney was notified by the U.S. Department of the Interior, Bureau of Reclamation, that a transitman position was available in Antioch. He grabbed it.

Antioch was headquarters for the Bureau's California Canal Division. During seven years there, Barney climbed the ladder from surveyor to director of all office engineering for three major projects: Contra Costa and Delta Mendota Canal, Delta Cross Canal, and Tracy Pumping Plant. In 1952 he was promoted to construction engineer in charge of all operations on the Solano project.

In 1957 Barney became director of the Bureau's Region 2, headquartered in Sacramento. There he was responsible for direction and execution of an integrated program for beneficial use of water within a region that enveloped a major portion of California plus contiguous areas in Nevada and southern Oregon. After two years in Sacramento, Bellport was summoned to Denver to become deputy to Chief Engineer Grant Bloodgood.

When Bloodgood retired in 1963, Bellport succeeded him as chief engineer of the U.S. Bureau of Reclamation. In this position he had jurisdiction over design, administration, and construction of Bureau projects in seventeen western states and Alaska. Approximately five thousand technical employees served under him. Outstanding examples in a long list of Bellport-administered projects include Morrow Point Dam in Colorado, the highest double-curvature thin-arch dam in the United States; Third Power Project at Grand Coulee Dam, eventually to become the world's largest single power facility; Monticello concrete arch dam in California; San Luis earth dam in California; Glen Canyon and Flaming Gorge Dams on the Colorado River; and joint development of Intertie, the nation's first and the world's longest extra-high-voltage direct current power line.

Barney possessed an uncanny ability to sort out competent employees and assign them to adaptable jobs. He thrived on hard work and, in that respect, set a good example for his associates. Denver office hours began at 7:30 A.M. but Barney usually arrived at 6:30. He had found that he could accomplish more in that one morning hour than in any three hours during the normal day.

Ever an advocate of innovation, Barney strove to encourage inventiveness among his designers. His frequent admonition, "Forget the way grandpa did it. Let's do it better!" inspired the appearance of surreptitious signs in the drafting rooms like "Hell with grandpa!" On the wall in Barney's private office hung a picture of a turtle under locomotion. The sign beneath it read, "He makes progress only when he sticks his neck out."

Although his official hitching post was in Denver, the chief engineer made frequent trips to visit field operations. Barney's wife, Mabe (for Maybelle), accompanied him on many of these jaunts. She was enthusiastically interested in construction and asked so many questions that many of the staff believed that she too was an engineer.

As time permitted, Bellport would carefully review the work output of his staff. From his breast pocket always protruded a large red-tipped felt pen. A vivid red question mark on a drawing or document was recognized by all as a signal saying, "Will the originator please come in and explain?" His critiques, however, were usually sprinkled with wry humor to make them palatable.

Barney Bellport was a popular boss, respected and liked by Bureau employees. That admiration was shared by most contractors on Bureau jobs. He advocated fair and reasonable specifications and equitable compensation, and believed that lower costs resulted from a healthy contracting industry. Nevertheless, he carefully guarded the interests of his employer, the government, and its taxpayers. He made friends among union officials by promoting fair working agreements and job safety.

On the other hand, the chiefs job was not all sweetness and goodwill. Political harassment was an inescapable annoyance. In our democracy, public disputes over water rights are bound to occur and be dropped into the laps of Washington politicians. Bellport's office was an interface between political controversy and physical accomplishment. His unbroken service through three federal administrations speaks well for his diplomatic skills.

Barney managed to spare time from his Bureau commitments to engage in extracurricular efforts as long as they were in the interest of better engineering. His committee involvement included memberships on the National Research Council's (NRC) Committee on Rapid Excavation; the NRC U.S. National Committee on Tunneling Technology; the U.S. Committee on Large Dams; the U.S. Committee on Irrigation, Drainage and Flood Control; and the Colorado State Research Advisory Committee. He was past president of the Colorado Chapter of American Society of Civil Engineers. He authored more than seventy published articles or public presentations on technical subjects.

Of the many honors that came his way, Barney most cherished his membership in the National Academy of Engineering.

He also received from the U.S. Department of the Interior its highest honor, the Gold Medal Award for Distinguished Service in 1967. The Beavers, a national organization of construction men, presented to him their Golden Beaver Award for Engineering in 1968. He was also named one of the American Public Works Association's Top Ten Public Works Leaders of the Year in 1970.

As mandated by the Civil Service Code, time arrived for Barney's retirement. On March 31, 1972, he turned over his office keys and red felt pen to his successor, Mr. Harold Aldrich.

A few months after retirement, Barney and Mabe sold their Denver home, said farewell to their many friends there, and flew back to California to a retirement home they had purchased in the community of Rossmoor in Contra Costa County, east of San Francisco. In Rossmoor, Barney kept as professionally occupied as he wished by accepting intermittent consulting assignments. To fill the gaps, he kept current on engineering affairs and restored antique furniture. On October 3, 1987, Barney Bellport died as a result of a massive cerebral hemorrhage. He is survived by Mabe, who still resides in Contra Costa; his daughter, Mrs. Louise Garcia of Dallas, Texas; and son, Barry, a stockbroker in San Francisco.


Charles M. Brinckerhoff

Charles M. Brinckerhoff

1901-1987

By Plato Malozemoff

Perhaps the most succinct tribute to Charles M. Brinckerhoff was the citation of the award in 1968 of the most prestigious honor in the mining industry, the William Lawrence Saunders Gold Medal for distinguished achievement in the field of mining, given by the American Institute of Mining, Metallurgical and Petroleum Engineers "for his outstanding administrative and technical ability and for discerning foresight and leadership in the minerals industry."

At the time of this award, he was chairman of the board and chief executive officer of one of the then two largest copper mining companies in the world, The Anaconda Company. This warm-hearted, gentle, fair-minded man of strong principles and vast experience, with over forty years of active participation in the mining industry, was admired and loved by his many friends and associates, and by the working men in the mines with whom he came in contact. He always listened with respect and attention to the opinions expressed by others, and was interested in and solicitous of their problems and misadventures. Yet he was firm and just in his decisions affecting people subordinate to him, which gained him universal respect. He was keenly interested in the young engineers entering the industry and helped them at every opportunity. He possessed a keen intelligence that gave him the ability to analyze a situation correctly, be it political, technical, financial, or organizational. He was dedicated to innovation in these fields.

Charles Brinckerhoff, born on March 15, 1901, was a graduate of Columbia University in New York City, having received his B.A. at Columbia College in 1922, and his metallurgical engineering degree from the Columbia University's School of Mining in 1925. During the first year out of college he was a cost engineer at Morenci, Arizona, for Phelps Dodge Corporation. He felt, however, that he should learn practical mining from scratch and moved to the Inspiration underground copper mine in Arizona, owned partially by The Anaconda Company. There he worked as a miner side by side with other workmen in drilling, blasting, and timbering. In those days drilling was done dry, without water that is used today, and this created rock dust-laden air in the workplace. This affected Charles' lungs, and he developed silicosis, which eventually was the cause of his death many years later. This impairment did not prevent him from having an illustrious career in mining during some fifty years. It was not until after his retirement in 1969 that the affliction began to affect his activities.

After a stint as a miner, he was made a mine foreman; then, an engineer. He worked at Inspiration from 1926 to 1935. The mine employed the so-called caving mining system, a method that calls for undercutting a block of ore, causing it to break up as it fills the void created by undercutting. This allows the broken ore to be drawn out without requiring drilling and blasting. The drilling and blasting are done only for undercutting and driving development and haulage headings as well as for sinking shafts and forming stations and other installations underground. With an acute perception of the mechanics of mining, Charles introduced numerous improvements in the practice of caving, which were employed by caving operations throughout the world.

In 1935 he was sent by The Anaconda Copper Company to Chile, where he took the position of an assistant mine superintendent from 1935 to 1937 at the Potrerillos mine of the Andes Copper Company, a subsidiary of Anaconda. Before he embarked for Chile, he married Florence Andreen, his lifetime loyal and charming companion. They had one daughter, Carol Kietzman.

He made steady progress in Chile from 1937 to 1948, becoming mine superintendent, then assistant to the general manager, and finally general manager of Andes Copper Mining Company. From 1948 to 1955 he served as the general manager of Chile Exploration Company, another subsidiary of Anaconda, which owned the Chuquicamata mine, the largest copper mine in the world. It was during this period that he directed the expansion of Chuquicamata, doubling its production.

The 1955 discovery of a new deposit, El Salvador, only twenty miles from the Potrerillos mine, led to the development of this mine by the Andes Company. The caving method was used at this mine but not very successfully. Charles, always looking for better solutions, established the practice of weakening the vertical boundaries of the block to be caved by driving raises and fan drilling the boundaries from the raises. This solved the main problem of this difficult orebody. He also made a number of other improvements in the operations, resulting in lower costs.

It was in the early 1950s that plans took shape to develop the great Toquepala orebody, one of three orebodies owned by Southern Peru Copper Corporation in Peru, the shareholders of which were American Smelting and Refining Company, Phelps Dodge Corporation, Cerro Corporation, and Newmont Mining Corporation. These shareholders were looking for a general manager and president for Southern Peru Copper Corporation who would be the best mining man available with experience in large-scale construction. Charles Brinckerhoff, everyone agreed, would be the ideal choice. He was interested, and a contract was drawn up with terms agreed on by everyone. On the morning Charles was to sign the agreement, he felt obliged before doing so to tell of his interest in this job to Clyde Weed, the chief executive officer (CEO) of Anaconda. When he did so early that day, Weed blew up and disclosed to Charles that he was destined eventually to become the CEO of Anaconda. He wanted Charles to stay with Anaconda, and Charles advised the Southern Peru shareholders that he felt he could not accept their offer after all.

Promotions at Anaconda followed rapidly until in 1958 he was made the president and in 1964 the chief executive officer.

After retirement in 1969, he was active as a consultant for several of the prominent mining companies in the United States. He was also a consultant to the Shah of Iran, who after expropriating the rights of Selection Trust of London to develop the great Sar Chesma copper mine decided to have Iran develop it. Charles advised him to hire the group of engineers who worked at the Chuquicamata mine and were then idle because the Chilean Communist government led by Allende had just expropriated it. The Shah agreed, and the Chuquicamata engineers designed the mine and facilities (mill, smelter, and refinery as well as the railroad and port). Charles undertook to negotiate an agreement on behalf of Iran with the contractors to do the construction. This took over two years to complete because all the terms had to be approved by the mine minister, who was very busy. During this time Charles commuted from New York to Iran every two months or so. With infinite patience and skill, he finally had the agreement approved by the minister, and construction started. By then Charles had had enough of Iran.

The Columbia Engineering School Alumni Association awarded Charles the Eglestone Medal:

> . . . for distinguished engineering achievement as a metallurgical engineer, mining engineer, executive and director of companies in the field of world metal resources, particularly as president of The Anaconda Company—devoted to the betterment of inter-American

> relations in the finest traditions of the engineer-diplomat; industrial representative for twenty three years in Latin America, enhancing both personal and corporate integrity in those countries where he served; holder of international honors in his field; devoted alumnus of Columbia University and member of the Columbia Engineering Council; steeped in the best tradition of his profession and ambassador without portfolio for that profession and the United States, both here and abroad, for the achievement of human welfare and human relations.

I always looked up to Charles Brinckerhoff as a beacon to be guided by. He pursued patient but steady progress in his career, which was deservedly crowned with one of the highest posts among the leading mining companies in America. Yet personally, and with his friends, he never changed—one felt he was always the Charles we knew before, attentive, interested in his friends, warm, and kind. I feel privileged to have known him for so long.

George H. Brown

1908-1987

Written by Kerns H. Powers

Submitted by William M. Webster

One of the world's leading experts on antennas and a near forty-year veteran of the Radio Corporation of America (RCA), George H. Brown died on December 11, 1987, at his home in Princeton, New Jersey. After a brilliant career in electrical engineering research and engineering management, George Brown retired from RCA in 1972. He is best known technically for his pioneering developments in directional antennas and for his invention of the turnstile antenna that has been used extensively for television broadcasting at very high frequencies (VHF) throughout the world. He is also well known as a participant in the team at RCA Laboratories that developed the dot-sequential color television system and as the team leader who relentlessly pursued its adoption as the U.S. standard for broadcasting. The principles embodied in that system are incorporated in all present-day systems of color television, including NTSC (National Television Systems Committee), PAL (Phase-Alternating Line), and SECAM (Sequentiel Couleur avec Memoire).

Born October 14, 1908, in North Milwaukee, Wisconsin, the son of a train dispatcher for the Chicago, Milwaukee and St. Paul Railroad, George Brown graduated from high school at Portage, Wisconsin, and entered the University of Wisconsin at Madison where he studied electrical engineering.

At the end of his junior year, he spent the summer in the Test Department at the General Electric Company in Schenectady, New York, a prestigious position for a college junior. An outstanding student who often took a heavier-than-normal schedule of courses, George won two highly competitive graduate fellowships administered by the University's Electrical Engineering Department. He received a B.S. in 1930, M.S. in 1931, and Ph.D. in 1933. While a graduate student at Wisconsin, George met and married Elizabeth Ward, also a graduate student, who would bear him twin sons and help to keep his life on an even keel for over fifty years.

After completing his studies at Wisconsin, George joined RCA at Camden, New Jersey, to do research in antennas and wave propagation. He moved to the new central research laboratories of RCA at Princeton, New Jersey, in 1942. From the position of member of the technical staff, he was appointed director of the Systems Research Laboratory in 1952; chief engineer, Commercial and Industrial Electronic Products at Camden in 1957; vice-president, Engineering, for the RCA Corporation in 1959; vice-president, Research and Engineering, 1961; executive vice-president, Research and Engineering, 1965; and executive vice-president, Patents and Licensing, 1968. He served as a member of the RCA board of directors from 1965 until his retirement in 1972.

In addition to his service to RCA, he served as a member of the board of directors of the Trane Company, La Crosse, Wisconsin, and of the First National Bank of Hamilton Square, New Jersey.

George was always active in engineering societies. He was a fellow of both the Institute of Radio Engineers (IRE) and the American Institute of Electrical Engineers (AIEE) before the merger of those two societies into the Institute of Electrical and Electronics Engineers (IEEE). He was also a fellow of the American Association for the Advancement of Science and of the Royal Television Society before which he delivered the prestigious Shoenberg Memorial

Lecture at the Royal Institution in 1972. He was a member of Sigma Xi, Tau Beta Pi, and was elected eminent member of Eta Kappa Nu in 1967. Among his many awards are the IEEE Edison Medal in 1967, the De Forest Audion Award of the Veteran Wireless Operators Association in 1968, and an honorary Dr. Eng. at the University of Rhode Island in 1968. He was elected to the National Academy of Engineering in 1965.

In spite of his busy schedule as an executive in RCA, he found time to serve on several advisory committees. These included the Ford Foundation Advisory Board, the Advisory Committee of the Office of Scientific Personnel of the National Research Council, advisory groups to NASA, the Postmaster General's Advisory Council on Research and Engineering, and, probably his favorite, the George Washington Council of the Boy Scouts of America. He served as a member of the executive board of the Council from 1954 to 1971. Starting as chairman of the Stony Brook District Committee in 1954, he advanced to a vice-presidential post on the Council in 1957 and to the executive committee in 1967, and served on the Region 2 Long-Range Planning Committee for several years. He was awarded the Silver Beaver Award of the Boy Scouts of America in 1962 and the Silver Antelope Award in 1969.

During his career at RCA, George Brown was awarded eighty patents and published over one hundred technical papers. Of the most significant patents are the turnstile antenna mentioned earlier; a vestigial-sideband filter for VHF broadcasting; and a method for bonding thermoplastic materials by radio frequency heating, used initially in the construction of plastic raincoats and still used today in the manufacture of plastic bags and other products. His early work on the design of directional antennas was published in the *Proceedings of the IRE* in 1935, 1936, and 1937, and has been republished in many engineering handbooks to the present day.

Perhaps the greatest challenge that George Brown faced in his illustrious career was his pursuit of color television standards in the United States and abroad. While he was still a member of the technical staff at RCA Laboratories, heading a small group in antenna and transmitter technology, an innovative team of researchers under Raymond D. Kell had developed the concept of a color television system that would be compatible with the existing black-and-white television system that was placed in service in the years following World War II. At about the same time a group under Dr. Peter Goldmark of CBS, who had been working for many years on a field-sequential method for color involving a revolving disk of color filters placed in front of both the television camera and the display tubes, had petitioned the Federal Communications Commission (FCC) for approval of the field-sequential system for commercial broadcasts in color. Although the field-sequential system was simple in principle, it required a higher bandwidth and was not compatible with the existing black-and-white service. That is, broadcasts in the field-sequential color system could not be viewed on the existing black-and-white television sets, even in black and white, because of the requirement for a different frequency of synchronization. The RCA Laboratories approach, called simultaneous color television, was more complex, also required a higher bandwidth, but at least had a measure of compatibility with the existing service and would not make obsolete the several million TV sets already sold. Hearings on the proposed CBS system were to be held before the FCC in the fall of 1949. Under the guidance of General David Sarnoff, then president of RCA, the Laboratories were directed in early 1949 to improve the simultaneous system and to prepare it for demonstrations before the Commission within nine months time. It was at this point that George Brown was assigned (without promotion) the responsibility to coordinate the efforts of the several groups at RCA working on the various aspects of color television and to ensure that the required equipment could be ready for the scheduled demonstrations. During this short period of time, major improvements to the system were invented, reducing the required bandwidth and improving compatibility. Thus new tests were required, new experimental equipments had to be constructed to supplement the existing equipment, and the many logistical tasks involved in setting up demonstrations had to be solved. Under George Brown's able leadership, the demonstrations were successfully carried out, with George personally writing much of the supporting documentation for the hearings. Although the effort failed in its attempt to convince the FCC that the compatible approach (by now called the dot-sequential system) was preferred over the incompatible field-sequential method, the entire television industry did become convinced, and the unfortunate FCC decision that selected the field sequential system as the U.S. standard was reversed three years later.

George Brown's reputation as a reconteur spread widely both inside and outside RCA. He was always in great demand as master of ceremonies for retirement and other social events, as his sarcastic wit and intriguing embellishments of true life stories about both friends and adversaries kept him in good stead for entertaining speeches, even on serious subjects. Through the encouragement of his many colleagues and friends, his early retirement years were devoted to writing his memoirs entitled *and part of which I was—Recollections of a Research Engineer,* (1979, Angus Cupar Publishers, 117 Hunt Drive, Princeton, New Jersey 08540), which is replete with his amusing stories while at the same time constituting a reliable history of the technical development of television broadcasting and related fields.

Nathan Cohn

1907-1989

By W. Spencer Bloor

Nathan Cohn, active for more than sixty years in the measurement and automatic control field, a pioneer in the development and application of control techniques for interconnected electric power systems, and elected to the National Academy of Engineering in 1969, died in Scottsdale, Arizona, on November 16, 1989, at age eighty-two.

Nat, as he was called by those who knew him well, was born in Hartford, Connecticut, January 2, 1907. Following graduation from the Massachusetts Institute of Technology in 1927, he joined the Leeds & Northrup Company and remained with the firm for forty-eight years. He retired from his position of executive vice-president in 1972 and from corporate director in 1975. Following his Leeds & Northrup retirement, he remained active presenting invited lectures, serving as corporate director of several technologically-oriented companies, devising new patented techniques for improving interconnected power system operational performance and control, authoring and presenting technical papers, working as senior technical associate of Network Systems Development Associates, and participating in volunteer work. Nat's engineering career was distinguished by both personal achievement and leadership of others.

In the field of control of interconnected electric power systems, he was a world-renowned authority. He authored ninety technical papers and a book. He was granted fifteen patents and established several interconnected system operating practices. Many of his patents and practices are widely used in the electric utility industry, and his publications, in the education of electric power engineers. In his specialty, he was in demand as a lecturer both in the United States and abroad. Included in the list of countries where he lectured are Canada, Brazil, Colombia, Peru, Russia, and Yugoslavia. For his personal technical achievements, Nat was elected a life fellow of the Franklin Institute, the Institute of Electrical and Electronics Engineers (IEEE), and the Instrument Society of America (ISA); and was awarded the Franklin Institute's John Price Wetherill Medal, the IEEE's Lamme Medal, and ISA's Albert F. Sperry Founder Award.

Nat's engineering leadership carried the hallmark of constructive accomplishment. Thorough advance preparation, well-understood plans, attention to the details of implementation, and high standards of excellence in results were characteristics of his leadership. During his ten years as vice-president of research and engineering at Leeds & Northrup, the company enjoyed a period of exceptional productivity in its output of new products of outstanding merit. His terms as president of the National Electronics Conference, the ISA, and the Scientific Apparatus Makers Association; and as chairman of the Franklin Institute's board of managers, the IEEE's Fellows Committee and Awards Board, and the Intersociety Hoover Medal Awards Board were marked by innovation, achievement, and the esteem of those he led. For leadership and career accomplishments, he was awarded the IEEE's Edison Medal, the Scientific Apparatus Makers Award, and honorary membership in the ISA; and made an adviser to the International Federation of Automatic Control.

The list of his services as member or chairman of committees or volunteer organizations is too long to recount in full. For the National Academy of Engineering, Nat chaired the Electrical Engineering-Communications/ Computers/Control

Peer Committee in 1975 and the Committee on Membership in 1977. For the National Research Council, he chaired the National Bureau of Standards Advisory Panel on Time and Frequency from 1969 to 1971 and the Panel on Instrumentation of the Physics Survey Committee from 1970 to 1973. For his alma mater, the Massachusetts Institute of Technology, he served on the visiting committees for libraries and philosophy. In the Philadelphia community, he was vice-president of the Eagleville Hospital Rehabilitation Center and a trustee of Keneseth Israel Reform Congregation.

Nat was a member of Eta Kappa Nu, Sigma Xi, and Tau Beta Pi, and received an honorary doctor of engineering from Rensselaer Polytechnic Institute in 1976. He was an avid sports fan and enjoyed boating, fishing, golf, and outdoor cooking.

He is survived by his wife of forty-nine years, Marjorie; their five children, Dr. Theodore E. of Berkeley, California, Dr. David L. of South Bend, Indiana, Dr. Anne H. of Chicago, Illinois, Dr. Amy E. Cohn-Tucker of New York City, and Julie Cohn Conner of Houston, Texas; and eight grandchildren.

Henry J. Degenkolb

1913-1989

By William J. Hall

Henry J. Degenkolb, a leading structural engineer in San Francisco, California, passed away on December 9, 1989, in San Francisco following a long battle with heart disease, cancer, and related ailments. His contributions to the community and to public safety will long be remembered as precedent setting for the entire engineering profession.

To most of us, earthquakes are frightening events, but to Henry Degenkolb, they were his laboratory. Perhaps more than anyone else, Henry established and demonstrated the art of "learning from observation" through visiting the sites of damaging earthquakes to determine why certain buildings performed well, while others were seriously damaged or collapsed. As one of the pioneers of "earthquake chasing," Henry Degenkolb was one of the few people willing to give of his own time and resources to visit the sites of damaging earthquakes all over the world. His observations were landmarks in the evaluations of seismic effects on engineered buildings and facilities in Kern County in 1952, Eureka in 1954, San Francisco in 1957, Anchorage in 1964, Caracas in 1967, Santa Rosa in 1969, San Fernando in 1971, Managua in 1972, Oroville in 1975, Guatemala in 1976, and Mexico City in 1985.

In explaining the importance of chasing earthquakes, Henry once said, "The principal reason for rushing to the site is to evaluate the earthquake and its effects on engineered buildings. It is really the only means we have of assessing and improving upon the quality of our work. You can apply theory to the limit, but the true test is to see how the construction performs under the stress for which it was designed."

Putting his research and analysis into practice, Henry Degenkolb was responsible for the structural design of some of the most distinctive structures in California. One of the first major jobs he handled was the structural design of the eleven apartment buildings that comprise the Parkmerced Towers in San Francisco, constructed in 1948. Since then, his structural design work has included downtown San Francisco's International Building, the Fireman's Fund Home Office Building, University of California at San Francisco's Long Hospital, and the Stanford Court Hotel. Henry Degenkolb was responsible for structural design of Bank of America branches and Pacific Telephone buildings throughout northern California. Additionally, he designed dozens of parking structures including the initial development of the parking structure at San Francisco International Airport, as well as ski chalet structures in the Sierra Nevada.

Well known for his technical innovations, Henry Degenkolb also designed the twenty-one-story Bank of California Building in downtown San Francisco, noted for its slurry wall construction and the "upside down" design of its three basements and foundations. Also Henry participated actively in the initial structural conceptual studies that subsequently led to the development, by longtime friend and colleague Professor Emeritus Egor Popov of the University of California, Berkeley, of the eccentric braced frame, a high-performance earthquake resisting system.

In addition to his technical innovations and designs, Henry Degenkolb will be remembered for his commitment to the engineering profession and his outstanding service to technical societies and professional organizations. As one of the early members of the Earthquake Engineering Research Institute

(EERI), he helped organize the First World Conference on Earthquake Engineering and participated in all succeeding world conferences on the subject.

Henry J. Degenkolb was born in Peoria, Illinois, on July 13, 1913, to Gustav J. and Alice (Emmert) Degenkolb. He attended the University of California at Berkeley, graduating with a B.S. in 1936. He married Anna Nygren in 1939, and they had five children, Virginia, Joan, Marion, Patti, and Paul.

His technical career began in 1936 when he became a design engineer for the San Francisco Bay Exposition Company, where he helped design buildings for the Golden Gate International Exposition of 1939 to 1940. At that time John Gould was the chief structural engineer for the company and later founded his own firm. Following various assignments, which included a copper refinery addition at Tacoma, Washington, in 1940, and work as assistant technical director for testing and analysis for a large-scale timber research program from 1940 to 1943, Henry Degenkolb joined Mr. Gould's firm in 1946 as its chief engineer. After ten years he became a partner in the firm, thus forming Gould and Degenkolb. Upon Mr. Gould's death in 1961, Mr. Degenkolb continued as president of the firm now known as H. J. Degenkolb Associates, Engineers, located on Sansome Street in San Francisco. The firm is recognized for handling difficult and unusual foundation and structural engineering problems in the San Francisco Bay Area and the state of California.

Henry Degenkolb was elected to membership in the National Academy of Engineering in 1977.

His professional affiliations included the following: fellow of the American Concrete Institute; honorary member of the American Society of Civil Engineers, chairman of its Structural Division Executive Committee in 1964, president of the San Francisco Section in 1964, and recipient of its Moisseiff Award in 1953 and its Ernest E. Howard Award in 1968; life fellow membership of the Franklin Institute and recipient of its Frank P. Brown Award in 1978; fellow of the Consulting Engineers Association of California, president in 1971, and director from 1968 to 1972; honorary member of the Earthquake Engineering Research Institute, and president from 1974 to 1978; member of the International Association of Earthquake Engineering, and U.S. representative from 1976 to 1978; member of the Seismological Society of America; member of The Society of American Military Engineers; member of the Structural Engineers Association of California, and president in 1958; honorary member of the Structural Engineers Association of Northern California, and president in 1957.

In other capacities he has been a lecturer, College of Engineering and Engineering Extension, University of California, Berkeley, from 1946 to 1961; member of the California Seismic Safety Commission in 1976; member of the San Francisco Bay Area Conservation and Development Commission including past-chairman, Engineering Criteria Review Board from 1970 to 1977; member of the California Building Standards Commission; member of the California Legislator's Committee on Seismic Safety; consultant to the California Public Utilities Commission; member of the Advisory Group on Engineering Considerations and Earthquake Science; consultant to the National Science Foundation; member of the Board of Examiners of the city and county of San Francisco; member, Building Seismic Safety Council; chairman of the Building Code Section of the San Francisco Chamber of Commerce from 1954 to 1960; and consultant to the U.S. Office of Science and Technology from 1970 to 1971 and from 1977 to 1978. He also served on the Advisory Panel for Earthquake Studies of the U.S. Geological Survey from 1978 to 1981. In the July 1, 1976, issue *of Engineering News Record,* Henry Degenkolb was credited with ". .. having more to do with the development of San Francisco's [building] code than any other individual in the past twenty years."

Henry Degenkolb was the author or coauthor of more than twenty-six formal publications. From 1972 to 1978 he carried major responsibility as part of a national group that developed the document *Tentative Provision for the Development of Seismic Regulations for Buildings,* under auspices of the Applied Technology Council (ATC) Report ATC 3-06. The provisions in this document, as subsequently reviewed and slightly revised, form the basis of the new seismic building provisions now being adopted throughout the United States.

He was licensed as a civil and structural engineer in California and as a civil engineer in Nevada, Oregon, and Wyoming.

The author of this memorial shall always be indebted to Henry Degenkolb for the "seismic engineering education" received during the long effort devoted to completion of the ATC study, and shall always remember with fondness the many walks in San Francisco with Henry Degenkolb while Henry recited the history and interesting structural features of the major buildings. Unselfish in all matters, Henry Degenkolb will long be remembered by his family, colleagues, and many friends.

Daniel N. Dietz

1913-1988

By Michael Prats

Daniel N. Dietz, a consulting engineer since 1984 after his retirements from Shell International Petroleum Maatschappij and then from the Delft University of Technology, died on April 15, 1988, following protracted lung complications. He was born in The Hague, The Netherlands, on November 7, 1913. In the almost five decades of his professional career, Professor Dietz left his footprints all over the field of petroleum technology and, later, mining engineering.

Daan graduated from the Delft University of Technology with a M.Eng. in engineering physics in 1940. His plans to join the Shell Group were deferred because of the war, so he obtained a position at the Dutch Hydrological Survey as a researcher in ground water management. Daan went underground the last part of the war to avoid being sent to a labor camp.

In 1945 he finally joined the Bataafsche Petroleum Maatschappij (which later became the Shell International Petroleum Maatschappij) as a reservoir engineer. After assignments in Indonesia, Venezuela, and the United States, he returned to The Hague as head of the Reservoir Engineering Section. In 1961 he was transferred to the Koninklijke/Shell Exploratie en Produktie Laboratorium in Reiswijk, outside The Hague, where he became head of the Thermal Recovery Section, a position he held until his retirement in 1973.

From 1973 to 1984 he was professor of reservoir engineering at the Department of Petroleum Engineering and Technical Geophysics, Delft University of Technology. During this period, Daan published on underground coal gasification, solution mining, subsurface disposal of radioactive wastes, seepage of oil from surface spills through shallow sands, pollution of ground waters, biodegradability of pollutants, and oil spill cleanup.

Most of Daan's early published work was in the field of reservoir engineering. His contributions to reservoir engineering included what has come to be known as the Dietz gravity tongue (from an article entitled "A Theoretical Approach to the Problems of Encroaching Edge Water" published in 1953, which can be considered the basis of modern reservoir engineering), the "steam soak" process, and the concept of partially quenched in-situ combustion. These ideas are widely known and respected, and have had a strong and lasting impact. Other noteworthy publications included an improved method for determining the average reservoir pressure from pressure build-up surveys and, more recently, a simplified technique for determining optimum production policy for a complex gas reservoir.

For his creative accomplishments in the application of scientific methods to the study of oil recovery processes, he received the John Franklin Carll Award from the Society of Petroleum Engineers in 1970. It is in this field, I think, that his reputation is greatest and most widespread. His interest in petroleum engineering was reflected by his contributions to the Society of Petroleum Engineers. He not only published regularly in the journals of this Society, but at the same time was a very active member, participating in committees, seminars, conferences, and meetings. Reservoir engineers the world over knew Daan Dietz and his work.

It is, however, very clear from the variety of articles published since his retirement from Shell that Daan Dietz had an universal mind, and that his interests certainly were not limited to reservoir engineering. Dietz has always emphasized physical understanding rather than mathematical virtuosity. In his view, mathematical virtuosity was acceptable only if the results could be formulated in simple physical terms.

Daan liked to formulate physical principles as paradoxes. His approach to problems was unconventional. Often he was able to pinpoint errors by physical intuition and made sharp remarks to those having difficulties catching on. Somehow, however, these remarks were appreciated by his students and staff as a particular sense of humor.

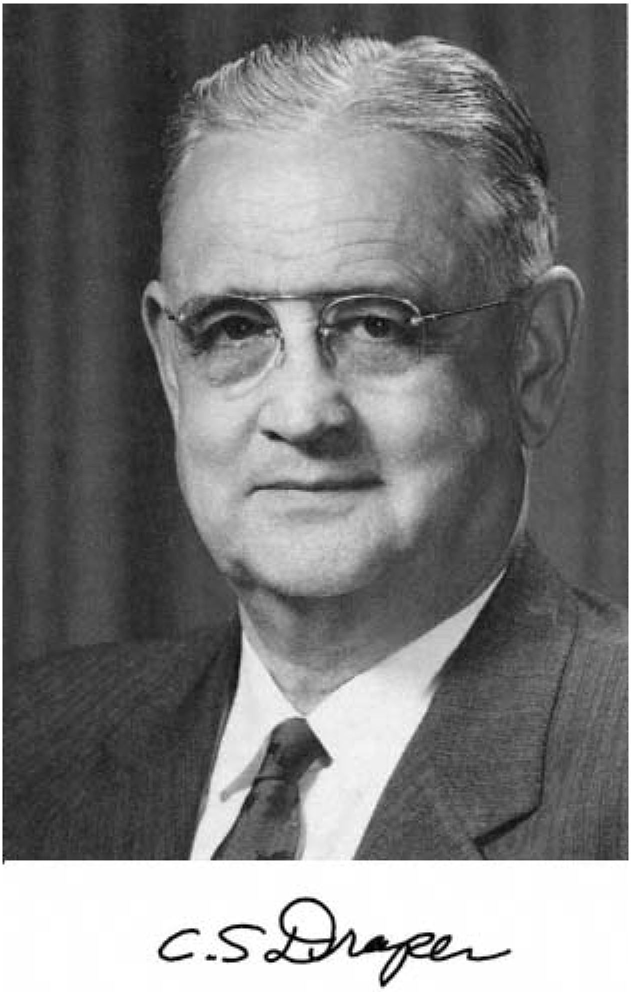
During his years at the University, Professor Dietz made high demands and thus attracted the better students in the department. There was a good atmosphere in which the formerly tiny section of reservoir engineering came to flourish as the largest section of the Petroleum Engineering Subdepartment.

Although I met Daan with some frequency, I never had the privilege of collaborating directly with him. But from watching others, I can say unequivocally that collaborating with Daan Dietz was definitely no laughing matter. It was an opportunity, but also a challenge: his combination of clear theoretical understanding and highly practical approach was difficult to match. His pipe in his mouth and pensive mood often gave way to broad smiles, but he was famous for his terse, sharp, and dry wit. At heart, however, he was a caring and gentle person.

Daan has given very much to the industry he worked for, and very much indeed to the students who studied under his guidance. He ranks high among the giants in reservoir engineering and related topics.

Whenever possible, Daan liked playing the violin in his office during the lunchtime break. He also spent as much time sailing as weather permitted, and made many trips from The Netherlands to Belgium, France, England, and Denmark in his twelve-meter sloop.

Daniel N. Dietz was elected a foreign associate of the National Academy of Engineering in 1988, but did not live to be present at the induction ceremonies.



Charles Stark Draper

1901-1987

By Robert A. Duffy

Charles Stark Draper, a complex genius of the twentieth century, was a modern version of the Renaissance man. A teacher, scientist, and engineer by profession, but self-described as a "greasy thumb mechanic," he was born on October 2, 1901. He grew up in the small Missouri town of Windsor where he went through the town's public school system. He entered college when he was fifteen years old at the Rolla campus of the University of Missouri as a liberal arts student. After two years, he transferred to Stanford University from which he graduated in 1922 with a B.A. in psychology.

Among all of the other things at which he excelled, Doc understood human beings and he understood how to challenge them towards a common goal. The psychology curriculum probably did no harm, but instinctively Doc knew how to lead and how to get people to follow to a common goal. He naturally interacted well with people. He liked and was interested in his students and his colleagues. His students and colleagues loved him in return. Above all, he lived for his technology—his life became the technology he nurtured to useful maturity.

He earned a B.S. in electro-chemical engineering at the Massachusetts Institute of Technology (MIT) where he went after Stanford. Despite short defections, he essentially remained at MIT for the rest of his life, immersed and totally involved in the developments associated with his measurement and control instrumentation. Legend has it that he took more courses at MIT than anyone else has ever taken. There he earned an M.S. in 1928 and a Ph.D. in physics in 1938. Doc's involvement with MIT became convincingly more permanent by the mid-1930s when he became an assistant, then an associate professor in aeronautical engineering. By 1939 he was a full professor.

It was during those early days, however, before advancing as a member of the junior faculty that he tried and failed to become an Air Corps pilot. Perhaps as a consequence of this rejection he enrolled in and quickly passed a civilian course qualifying him to fly. He acquired an airplane and recognized the need to improve the pilot's flight instrumentation. He taught a course in aircraft instruments concurrently. To make his point about instrumentation inadequacies, he took Professor Jay Stratton, later to be president of MIT, up in his airplane and showed him how one used the flight instruments, indicating shortcomings he had perceived. He caused the airplane to perform stalls and spins over Boston's outer harbor. Professor Stratton was duly impressed by the inadequacy of the instrumentation and Draper's ideas about needed improvements. He did not fly again with Draper!

Draper really pursued three major thrusts in his life's work: measurement of physical processes, primarily the instrumentation of dynamic geometry; the systems engineering of those processes in the larger context of new concepts; and, finally, the education of the engineering profession. Following his early experiments with basic instruments, the solution of the dynamic geometry problems associated with gunfire control, both on fixed-wing aircraft mounted guns and with deck-mounted antiaircraft guns, occurred first. The second major thrust was the systems study, analysis, and synthesis that came from using instrumentation to measure quantities that are part of a larger issue. Here his conceptualization and vision were applied to what we later termed the systems engineering process. The solution was usually implemented by some control means using intelligence from the sensory elements processed through what Draper termed the informetics of some computational element.

In the development of this process, Draper and his people, Bob Seamans leading, developed and demonstrated the first all-attitude adaptive autopilot. Rocket and gunfire control systems and the early inertial navigation and guidance systems followed.

In the age of Apollo, the unheard-of challenge of putting men on the moon and safely returning them to Earth appealed to Doc as a prime application for his technology. The creation of the guidance, navigation, and control elements in the Apollo program was inspired by Draper although many others made fundamental contributions.

Underlying all of that was the third, and perhaps the most important, of all his interests—the education process that he created when he had both the MIT Aeronautical Engineering Department and his Instrumentation Lab under his direct control. "Mens et Manus," minds and hands—the MIT motto—had real meaning in this context. The invention and creation of the elements that went with measuring and controlling complex functions and processes served as a superb environment for learning. His Instrumentation Laboratory, the Aero Department and its distinguished faculty, and the long list of his students led by him into leadership positions are as much his legacy as the magnificent systems capabilities he created. His entrepreneurial spirit and verve, concepts like navigating in a "black box" so that a submerged vehicle can know its position and velocity without external reference, the creation of spacecraft and booster guidance systems, a mathematical language—the so-called Draper notation—optimalization as a control theory, and the conceptualization with Milton Trageser of a Mars mission in the 1950s are all as much a part of this genius as his care and concern for children and the young.

Draper became a public person with the Apollo program.

Although he had been honored by both the Air Force and the Navy for his wartime contributions, it wasn't until the Apollo program began that the nation as a whole knew Charles Stark Draper. Even before President Kennedy made the public announcement that within the decade man would be landed on the moon and brought back safely to Earth, Draper, always with an ear to the ground, had seen that evolving challenge as applying to him and his laboratory. He and his people, using the Mars reconnaissance system design as a background, had been working for several years attempting to get government support. With the formation of the Apollo program as the triggering event, he went to James Webb, who had been appointed administrator of the new National Aeronautics and Space Administration, offering to design, build, and fly the Apollo guidance, control, and navigation system. Webb and Hugh Dryden (of National Advisory Committee for Aeronautics heritage) believed Draper's statements to the effect that navigation to the vicinity of the moon without external aid was feasible. The Instrumentation Laboratory received the first contract award made by NASA for the moon program.

The design of the guidance, navigation, and control equipment was not an extraordinary task for the Instrumentation Laboratory. Thus, the challenge for the Instrumentation Laboratory was not to prove a concept or even a technology but rather to adapt the system to the extraordinary distances and the demanding reliability requirements of the manned moon mission. In actuality the version of Draper's system implemented by Dave Hoag and his team used both a star tracker and accepted radio position and velocity updates from NASA's long base-line earth-based tracking stations—a sort of belt-and-suspenders solution that worked.

Draper died on July 25, 1987. Draper Laboratory along with the MIT community honored him in a memorial service during the fall academic session of 1987 when his long-term friends and colleagues had returned to the campus. MIT has two endowed chairs in his name (for junior faculty members) in the Aeronautics and Astronautics Department. The Draper Laboratory awards graduate fellowships at MIT and supports military officers studying for graduate degrees at MIT, all in Draper's name.

Dr. Draper was elected to the National Academy of Sciences and the National Academy of Engineering, and as a foreign associate member to the French Academy of Sciences. He was president of the von Kármán Foundation, The International Academy of Astronautics, and The National Inventors Council. He had many academic honorary degrees and citations.

The board of directors of the Draper Laboratory authorized an annual award in Draper's name to be administered by the National Academy of Engineering. The award honors the engineer who has contributed most to engineering in the opinion of the NAE-appointed selection committee. The award approximates the Nobel award in value, is permanently endowed, and is expected to be given every two years.

Dr. Draper is survived by his wife, the former Ivy Hurd Willard, and four children, James, Martha Draper Ditmeyer, John, and Michael. The Drapers lived for many years in Newton, Massachusetts, where Mrs. Draper now resides, remembered fondly for her strong support of Draper through many long years of extended separations, interminable Saturday sessions in her home, and memorable parties and picnics for Doc's students and colleagues.

Harold E. Edgerton

1903-1990

By Gerald L. Wilson

Professor Harold E. Edgerton of the Massachusetts Institute of Technology, the inventor of high-speed photography, the man whose genius transformed the strobe light from a laboratory curiosity into an important tool for science, industry, and the military, died at the age of eighty-six on January 4, 1990.

At the Massachusetts Institute of Technology (MIT), where he had been a faculty member since 1932, his official rank was institute professor, an honor bestowed on only a handful of faculty. His unofficial title—one he bore as proudly as the loftier one—was simply Doc. He was called that by nearly everyone, from first-year undergraduates to MIT's incumbent president, who had been one of Doc's students in the early 1950s.

An internationally eminent electrical engineer, Dr. Edgerton also was known for developments in sonar technology, which he applied to geology, archaeology, and undersea explorations.

It was as a photographer of the "unseen" that Dr. Edgerton was best known to the general public. Millions of people have seen his stop-action photos, which have frozen the rapidly fluttering wings of a hummingbird, "stopped" a bullet as it shattered a light bulb, or revealed the power and grace that underlie athletic competition.

He lived by a credo that is easy to state, but difficult to follow. A Boston newspaper, published the morning of the day he was to die, quoted it in reporting yet another honor for him from a professional organization. "Work like hell, tell everyone everything you know, close a deal with a handshake, and have fun."

He was born in Fremont, Nebraska, April 6, 1903, and grew up in Aurora, Nebraska. While in high school, Professor Edgerton worked as a janitor, meter reader, coal handler, and lineman for the local power company, and he planned to make a career in the power industry. After graduating from the University of Nebraska with a degree in electrical engineering in 1925, he joined General Electric Company in Schenectady, New York.

But after a year there and at the urging of his father, a lawyer and newsman who was well-traveled and had a high regard for the northeast and its academic institutions, he went to MIT for graduate work. Professor Edgerton received an M.S. in 1927 and became a research assistant in what then was called the Department of Electrical Engineering. He earned his Sc.D. in 1931 and was appointed to the faculty the next year.

It was while working on his doctoral thesis that Professor Edgerton first turned to stroboscopic photography. Needing to determine the exact position of the armature of the synchronomous motor he was studying, Professor Edgerton rigged a mercury vapor lamp so that it would flash at the same speed as the rotating armature. He succeeded in taking excellent pictures of less than ten microseconds duration.

The first flash picture—using a spark—had been made in 1851, very early in the history of photography, but the technique had been treated as a curiosity until Edgerton came along.

Captivated by the success of the armature picture, Dr. Edgerton and one of his students, Kenneth J. Germeshausen—both enthusiastic amateur photographers—began making still and motion pictures of all kinds of objects in rapid motion.

Dr. Edgerton also made many advances in high-speed motion picture techniques. He devised a system by which action is photographed at a rate of many flashes a second with an open shutter. The exposures are made by strobe flashes on a continuously moving film.

During World War II, Dr. Edgerton was asked to devise a strobe system for nighttime aerial photography of ground targets and operations. He developed the necessary apparatus and traveled to Italy and England to supervise its installation and testing. It was used effectively in the Normandy invasion in 1944. After the war, Edgerton, Germeshausen, and Herbert E. Grier, another former student of Edgerton, were asked to photograph the first peacetime test of an atomic bomb. From that project the company got involved in developing the high-speed circuits that triggered such explosions.

In 1952, when the National Geographic Society asked Dr. Edgerton to develop an underwater camera for Jacques Cousteau, the MIT professor began a collaboration with the famous French explorer that continued for many years. Cousteau's crew called Edgerton Papa Flash.

Professor Edgerton's pioneering work with side-scan sonar included development of equipment that could reveal not only the existence of objects on the ocean bottom, but also their shapes. With such apparatus, Dr. Edgerton and Cousteau explored parts of the Mediterranean. They located the *Britannic,* a hospital ship sunk by a mine in the Aegean Sea during World War I, and various ancient wrecks. With the same group, he made a successful archaeological survey in Lake Titicaca, near the Inca Temple of the Sun. In 1973 Dr. Edgerton helped find the remains of the Civil War ironclad *Monitor,* which sank in a storm off Cape Hatteras.

In 1983 MIT dedicated the five-story EG&G Education Center, designed for teaching and conference purposes. Dr. Edgerton gave the first lecture in the hall bearing his name on a subject on which he was an unquestioned authority, the "History of Strobe Photography."

Dr. Edgerton was married in 1928 to Esther May Garrett. They had been childhood friends in Aurora, Nebraska. Their children are Mrs. Mary L. Dixon of Hickory, North Carolina, and Robert F. Edgerton of Pontiac, Michigan.

In 1986 he was inducted into the National Inventors Hall of Fame for his invention of ultra high-speed photography. The patent for the specific invention cited, "Stroboscope," was issued August 16, 1949.

Other awards and honors included the Certificate of Appreciation from the War Department and the National Medal of Science, 1973.

His memberships included the Academy of Applied Science, Academy of Underwater Arts and Sciences, American Academy of Arts and Sciences, American Philosophical Society, and Boston Camera Club (honorary). He was elected to the National Academy of Engineering in 1966.

Dr. Edgerton was a fellow of the Institute of Electrical and Electronics Engineers, Photographic Society of America, Royal Photographic Society of Great Britain, and the Society of Motion Picture and TV Engineers.

For all of his long career, accessibility to students was a hallmark of Professor Edgerton. His office door was always open, and although he might tell a visitor that he had "just five microseconds," he would spend hours with students, especially freshmen, sharing the excitement of a new experiment. Professor and Mrs. Edgerton often entertained students at their Cambridge apartment where a strobe light was used to flash a welcome at the door.

Not long after his death, the MIT student newspaper published a letter from a student who had graduated in 1989. She wanted to relate an incident that had involved her and Professor Edgerton, "one of the most warm-hearted people I have ever met." Her letter captured the essence of MIT's beloved Doc.

The student wrote that she encountered Professor Edgerton one day in 1988 when she was walking along the campus in tears over a personal incident. They had not met before.

He invited her to his home, introduced her to his wife, and they shared their dinner with her.

At this point in her letter there is a memorable passage, more touching perhaps because the writer is not a native speaker of English.

"After the dinner, he went under the dining table and asked me to come under as well. I wondered if he liked to rest under the table after meals, but I soon found out why. There were a lot of writings on the reverse of the table. Many of them were the signatures of people who had visited, some with greetings. He gave me a pen and I wrote my name in Japanese .... After that day they invited me over several times. Some times they would give me take-home food so I could have it for breakfast. Dr. Edgerton told me that I was his first Japanese granddaughter . . . In our lives we seldom meet people who really touch our heart . . . I greatly miss my beloved Grandpa Edgerton, like those who were also touched by his warmth during his life."

Martin A. Elliott

1909-1988

By Henry R. Linden

Martin A. Elliott, a major figure in the field of fuel science and engineering, and especially synthetic liquid-fuels and gas research, died on August 5, 1988, in Eugene, Oregon, while recuperating from coronary bypass surgery. Although retired for fourteen years following his last full-time position as corporate scientific adviser of Texas Eastern Transmission Corporation, he had remained active as an energy consultant and continued to serve as member emeritus of the Industry Technical Advisory Committee of the Gas Research Institute. He also continued his contributions to the technical literature, most notably as editor of *Chemistry of Coal Utilization* and author of key chapters.

Martin Elliott was born in Baltimore, Maryland, on February 21, 1909, graduated from Baltimore Polytechnic Institute in 1927, and received from the John Hopkins University a B.E. in 1930 and Ph.D. in 1933, both in gas engineering. While a graduate student, he met his wife of almost fifty years, Mary Helen Parker Elliott, who died in 1982. Their humor, grace, and exceptional mutual devotion overcame ill health and infirmity during their final years together. Martin Elliott died in the home of his second wife, Shirley Whitlock Elliott, who was a great comfort to him.

Martin started his lifelong involvement with gas and fuels technology as an engineer for Consolidated Gas, Electric

Light & Power Company of Baltimore (now Baltimore Gas & Electric Company) in 1934. In 1938 he began a fourteen-year association with the U.S. Bureau of Mines in Pittsburgh, where he rose to chief of the Synthetic Liquid Fuels Research Branch. In 1950 he was a key member of the team of U.S. scientists and engineers who traveled throughout Europe to gather information on synthetic liquid-fuels processes. My close association with Martin Elliott dates back to 1952 when he came to the Illinois Institute of Technology (IIT) as research professor of mechanical engineering. From 1956 to 1961 he headed the Institute of Gas Technology (IGT), an affiliate of IIT, and then served as vice-president of academic affairs at IIT until 1967. Thereafter, he went to Houston to continue his service to the gas industry as corporate scientific adviser of Texas Eastern Transmission Corporation until his retirement in 1974. Also in 1974 he was elected a fellow of the American Society of Mechanical Engineers (ASME), and in 1975 he received the first Gas Industry Research Award from the American Gas Association for his lasting and significant contributions to gas industry technology. In 1976 he was elected a member of the National Academy of Engineering.

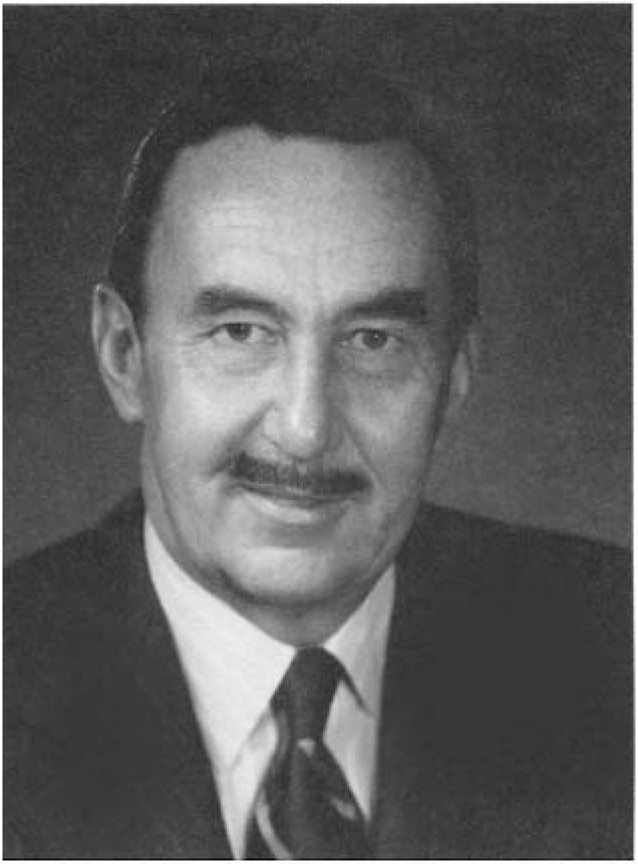
Much of today's understanding of the fundamentals that govern the conversion of coal and oil shale to synthetic fuels is based on Martin Elliott's work and the research he initiated and guided while serving at the Bureau of Mines and at IGT. He served on numerous prestigious scientific and advisory bodies in connection with his lifelong dedication to improving the technology and economics of synthetic fuels production and played a major role in IGT's development of novel fossil-fuel gasification processes.

Earlier in his career he was also deeply involved in the fields of combustion and explosives, making major contributions to the safe operation of diesel engines in underground coal mines and the safety of liquefied natural gas storage and use. In 1952 the Secretary of the Interior bestowed upon him the Interior Department's highest award, the

Distinguished Service Medal, for his work at the U.S. Bureau of Mines. In 1967 he also received the Percy Nicholls Award of the Fuel Division of ASME and the Coal Division of the American Institute of Mining, Metallurgical and Petroleum Engineers for his contributions in the field of solid fuels.

No memorial tribute to a leading technologist would be complete without a listing of the traditional measures of his impact on his field of specialization. Let me present a somewhat condensed treatment of this aspect of Martin Elliott's life's work. He authored more than one hundred papers on fuel and gas technology and on the future producibility of fossil fuels. In 1954 he chaired the Gordon Research Conference on Coal Science. From 1957 to 1962 he was a member of the Committee on Chemistry of Coal of the National Academy of Sciences-National Research Council. He was chairman of the diesel engine test code committee of the Society of Automotive Engineers; a member of the board of directors of Autoresearch, Inc., Utah Shale Land Corporation, and the Adler Planetarium, all of Chicago; and active on committees of the Coordinating Research Council of the petroleum and automotive industries. From 1964 to 1967 he was a member of the Science Advisory Council to the Governor of the State of Illinois. In 1966 he was appointed a member of the National Research Council's Committee on Mineral Science and Technology and chairman of its Panel on Fuel Science and Technology. He became a member of the Coal Advisory Committee of the Illinois Geological Survey in 1961 and an honorary member in 1967. In 1967 he was appointed a member of the General Technical Advisory Committee of the Office of Coal Research of the U.S. Department of the Interior and became a member of the International Gas Union's subcommittee on the production of synthetic gaseous fuels.

This brief summary of his distinguished career in research and education fails to capture the essence of Martin Elliott's impact on the field of fuel science and engineering. A very modest man, he shunned the limelight and devoted a large measure of his formidable energies to cooperative efforts that served a wide range of professional, national, and global interests in the energy field. He was an exceptionally devoted and effective mentor to younger colleagues, whose subsequent achievements reflected Martin's guidance and wisdom. I was among them. He was also a tireless analyst and innovator, again without concern for receiving credit from his peers or in publications and patents. Thus, the record of his life's work, impressive as it is, greatly understates his full contribution. His intellectual curiosity led him to the pursuit of numerous challenging issues, such as what the economically and technically recoverable natural gas resource base of the United States really is. In 1968 he coauthored a seminal study conducted under his direction that accurately projected today's assessment of the size of this resource base. Remember, this was a time when the conventional wisdom was that depletion was imminent. I offer this merely as an illustration of the true measure of Martin Elliott, whose memory is cherished by all those whose lives he touched.



Elliott M. Estes

1916-1988

By Robert A. Frosch

Elliott M. (Pete) Estes, an engineer who rose through the ranks of General Motors (GM) to become its fifteenth president and a true pioneer in the auto industry, died on March 24, 1988. He was on his way to a meeting of the board of directors of Kellogg Corporation in Chicago when he collapsed on the street at O'Hare Airport. He was pronounced dead of a heart attack at Resurrection Hospital shortly afterward.

Thus ended the life of one of the great men of General Motors—a man who saw his industry and his company undergo tremendous and dramatic change. And throughout his career, he was in the forefront of that change.

It all started in the southwest Michigan town of Mendon, in the old Wakeman Hotel, owned by his grandparents, on January 7, 1916, when Elliott Marantette Estes was born. His mother worked at the hotel and his father was a bank clerk. At a very early age, Pete showed an interest in machinery and "things that move."

At age fourteen he learned to drive and repair his parents' Reo Flying Cloud automobile; he was interested in the steam engines and threshing machines on an uncle's farm; and he once even outfitted his coaster wagon with a one-cylinder engine.

When Pete was about age ten, he and his family moved to the nearby town of Constantine, where he finished high school and got his first job—making butter in a local creamery. He liked making a dollar a day at the creamery and thought that was a good place to be, particularly when the National Recovery Administration's regulations raised his pay to $3.20 a day—until he found that his boss, who had been there for years, made only $5 a day. That seemed not to be a very inviting future, and he began to look for other opportunities.

At the suggestion of a cousin, Pete applied to General Motors Institute (GMI)—probably the best career move he ever made. Because he did well in his first year, he was assigned to the GM Research Laboratories and was an apprentice to the founder of the laboratories, Charles F. "Boss" Kettering. Kettering was a prolific inventor and eventually gathered in more patents than any American except Thomas Edison.

Through four years at GMI and two years at the University of Cincinnati where he earned his degree, Pete spent half his time in the classroom and half at the research lab at the side of Boss Ket. Pete often reflected on the profound influence Boss Ket had on his life. Ket believed in "letting the engine tell you whether or not it is designed right—it doesn't care what school the designer attended or how smart he is."

Pete left the research labs in 1946 and took a job as a motor development engineer at Oldsmobile. He considered that his first big break in the corporation—it gave him the opportunity to work on the famous Olds Rocket V8 engine, the industry's first high-compression engine. Pete said that engine "put Oldsmobile on the map" and helped him to advance through several promotions to assistant chief engineer at Oldsmobile.

When Semon E. (Bunky) Knudsen became general manager of Pontiac in 1956, he summoned Pete to be his chief engineer. Together they changed Pontiac's image from an "old lady's car" to a younger and hotter number. In those years Pontiac brought out the perimeter frame, the 4-cylinder Tempest with front-mounted engine and rear-mounted transmission for better weight distribution, and the famous Pontiac "wide track" principle.

At age forty-five Pete was appointed a GM vice-president and general manager of Pontiac—the youngest general manager at any of the GM car divisions. Pontiac captured third place in the new car registrations for the first time, and the *New York Times* called Pete "automotive management's rookie-of-the-year." Pontiac's share of the domestic market rose from 6.4 percent in 1961 to 9.5 percent in 1965.

Pete's successes at Pontiac earned him the spot of general manager of Chevrolet. In 1965, the year he took over, Chevrolet built three million cars and trucks—the first single manufacturer in history to do that in one calendar year. Pete earned the reputation of being a relentless competitor. When Ford began to close in on Chevrolet for first place by bringing out the very successful Mustang, Pete countered with the Camaro that became one of America's most popular production line sports cars and enabled Chevrolet to hold on to first place.

After Chevrolet, Pete continued his rapid rise up the corporate ladder. In 1969 he became group executive in charge of the car and truck group. A year later, he was named head of the overseas operations. In 1972 he was appointed executive vice-president in charge of the operations staff and became a director of the corporation. He was named president of General Motors on October 1, 1974.

In his forty-six years with General Motors, Pete Estes served the corporation well in many capacities—as student, engineer, manager, administrator, and top executive. He demanded excellence from his subordinates, but he always drove himself harder than anyone else. His contributions were many. He provided the major impetus for GM's massive product down-sizing program, which eventually touched every product line and resulted in a 93 percent increase in the fuel economy of the GM fleet by the time Pete retired in 1981. He pioneered

GM's electric car technology, and he moved the corporation aggressively toward achieving and surpassing federal government safety, pollution, and fuel economy standards.

With his great warmth and sincerity, Pete always brought out the best in people. He was one of the great communicators in General Motors. He received the same enthusiastic response whether he was making a speech, appearing on TV, shaking hands at a reception, or in a one-on-one interview with reporters. He is remembered by his associates and many others for representing his country so well in the British Broadcasting Corporation's documentary series "Americans."

He carried the same diligence and enthusiasm into his non-GM activities: as the first chairman of the Meadow Brook Festival and Theatre in Rochester, Michigan; and as a member of the Founder's Society of the Detroit Institute of Arts, the Society of Automotive Engineers, and numerous other clubs, foundations, and boards of directors.

As one of the foremost leaders during times of great change in the automotive industry, and for his many contributions to engineering that helped to revolutionize that industry, E. M. (Pete) Estes is most deserving of a memorial tribute in the National Academy of Engineering.

William L. Everitt

1900-1986

By Edward C. Jordan and
George W. Swenson, Jr.

William L. Everitt, dean emeritus of the College of Engineering, University of Illinois at Urbana-Champaign, died on September 6, 1986. His was a truly illustrious career as scientist-engineer and engineering educator, with a worldwide reputation as a leader in the field of electronics and communication engineering. Through his writing, particularly his textbook *Communication Engineering,* he profoundly influenced several generations of electrical engineers and laid the groundwork for many of the developments in telecommunications of the past half-century. His pioneering efforts were instrumental in expanding from a field dealing almost solely with electric power to one encompassing communication and electronics and all their extensions into the modern aspects of the field. Because of his leadership in engineering education, this transformation, accomplished successfully at his own institutions, hastened the process of change throughout the nation.

He was born April 14, 1900, in Baltimore, Maryland, and pursued his early academic career at Cornell (E.E., 1922) and the University of Michigan (M.S., 1926), while serving as an instructor of electrical engineering at both institutions. Between the times he was at the universities, he spent two years as an engineer at North Electric Manufacturing Company in charge of automatic PBX development. He also spent five summers with AT&T in the Department of Development and Research. With his background of real-world engineering experience, he began a remarkably productive eighteen-year career at the Ohio State University (OSU). It was at OSU that he developed the principle of the radio altimeter, which is now used as standard equipment on all the larger aircraft. Here also he developed the theory of Class C amplifiers (the main subject of his Ph.D. thesis) as well as Class B amplifiers and introduced the concept of piecewise linear analysis of large-signal electronic circuits. He also developed the systematic design of networks to couple transmitters to antennas (including the almost universally used pi network), and, of course, antennas. The results of this work had immediate applicability and were transmitted directly to the practicing engineer through the medium of the first Broadcast Engineering Conference, which he organized at OSU in 1939.

The book *Communication Engineering* brought graduate students from all over the world to the Ohio State University and the University of Illinois. This text, first written in 1932, has gone through three editions, and there have been several foreign translations including an early pirated Japanese edition. The book was a standard source in communication engineering for more than thirty-five years. It was really the first textbook to use the modern approach of incorporating recent research results in a form suitable for classroom presentation.

During World War II, Dr. Everitt was called to Washington to serve as director of the operational research staff, Office of the Chief Signal Officer, U.S. Army. For this work, he was awarded the War Department's Exceptionally Meritorious Civilian Award. After the war, he became head of the Department of Electrical Engineering at the University of Illinois, and in 1949 was named dean of the College of Engineering. At Illinois, Everitt recruited an outstanding faculty and developed a strong research program that propelled the department and college to the front ranks of engineering education. His leadership as an educator is evidenced by the fact that he has held nearly every major office in the key professional and engineering education societies. He has been president of the Institute of Radio Engineers, the American Society for Engineering Education, and the Engineers Council for Professional Development. He has also been awarded major medals or awards by these and other professional societies. As was typical of Dr. Everitt's efforts to keep up with the technical advances of his field, he undertook the editorship of the Prentice-Hall series of Electrical Engineering texts. In this capacity, he edited more than one hundred textbooks, ranging from basic electrical engineering through information theory, to the physics of microwave propagation.

After "retirement" as dean in 1968, he vigorously pursued his professional activities, serving for five years as the very active chairman of the Committee on Telecommunications of the National Academy of Engineering (of which he was founding member), and more recently as chairman and member of the Support Panel of the Office of Telecommunications of the Department of Commerce. Under his chairmanship, several significant reports, such as *Communications Technology for Urban Improvement, Telecommunications Research in the United States and Selected Foreign Countries,* and *The Application of Social and Economic Values to Spectrum Management* were issued.

Throughout his career, Everitt gave selflessly in service to his fellow man through contributions at the community, state, and national levels. He has a lifetime record of service to his country through the U.S. Department of Defense.

The effect of Everitt's work on electrical engineering science was recognized in part when he was made president of the Institute of Radio Engineers in 1945; in 1954 when the institute bestowed upon him its highest award, the Medal of Honor "for his distinguished career as an educator and scientist; for his contributions in electronics and communications as a major branch of electrical engineering . . .";

and in 1963 when he received the Mervin J. Kelly Award of the Institute of Electrical and Electronics Engineers "for outstanding leadership and many contributions in the field of telecommunications." His impact on engineering education has been cited in many of the honorary degrees and awards that have been bestowed upon him:

> "One of the outstanding leaders of all time in engineering education."
> "For exceptional leadership and innovation in engineering education, distinguished contributions to science and advancement of the engineering profession, and meritorious service to society."

He was a founding member of the National Academy of Engineering, and he was honored by scores of awards and citations from national and international professional and governmental agencies, including honorary doctorates from ten universities in the United States and abroad. In 1984, at the centennial celebration of the Institute of Electrical and Electronics Engineers, he was named one of the top ten electrical engineers of all time and one of an even more select group of top engineering educators.

Ulrich Finsterwalder

1897-1988

By Anton Tedesko

This uniquely gifted, internationally renowned structural engineer was born in Munich, Germany, on December 25, 1897, and he died there on December 5, 1988.

Finsterwalder lived a full life, remaining active until the very end, which came after a brief illness. He was an enthusiastic skier in the Alps and continued when he was past ninety. The task of running his farm was another source of enjoyment.

Of the great structural engineers of this century, Ulrich Finsterwalder should perhaps be ranked among the top half-dozen. Among this group he was the most versatile. Finsterwalder was known for his creative construction ideas, and he had a decisive influence on the modern art of engineering and construction.

Finsterwalder was a designer-constructor, researcher, inventor, entrepreneur, and author. For many years he was the chief engineer and the driving force behind the works of Dyckerhoff & Widmann A. G. (Dywidag), the Munich-based design and construction firm well known for its pioneering of reinforced concrete. He eventually became a member of the firm's executive committee. In recent years he was an independent consultant.

Finsterwalder was a designer of numerous monumental and unique structures including buildings, highways, bridges, dams, shell-type concrete ships, vessels for the transport of liquefied natural gas, floating harbors, and tunnels. The Dywidag thread bar, a device that has become standard on many construction jobs throughout the world, was one of his inventions.

He was among the leading innovators in prestressed concrete, and many of today's standards of that material are the result of his original ideas decades ago. Finsterwalder was a pioneer in free cantilever construction, which is now known as segmental construction; he originated the stress ribbon bridge and supervised the design and construction of one of the first cable-stayed bridges in concrete.

His father, Dr. Sebastian Finsterwalder, a Bavarian, was professor of mathematics at the Munich Institute of Technology and became the originator of the fundamental principles of modern photogrammetry. His mother was a member of a well-known family from the mountains of South Tyrol, which was then a part of Austria.

As a teenager, Ulrich Finsterwalder served in World War I. Captured by French troops, he spent two years in a prison camp, a time he used to study mathematics, which became the foundation for his later scientific efforts and his life as an engineer.

The following story is illustrative of his personality: The ancestral family house stood in the southern part of the Tyrol mountains. After the war this part of the Austrian province became a permanent part of Italy; the change was strongly resented by the population of South Tyrol. In addition, the Finsterwalder family objected to fortifications and antiaircraft batteries installed by the military very close to the family home. Ulrich Finsterwalder decided that the house should be moved. He organized his brothers and with them he patiently numbered every beam and board and carefully took the chalet-type house apart, piece by piece. With his brothers he trucked the material one hundred miles to North Tyrol where they reassembled the house at the foot of mountains that are quite similar to those where the house had previously stood. Today the old family home stands in Going, Austria.

Ulrich attended the Munich Institute of Technology and graduated with a doctorate in engineering, based on a thesis of his bending theory of cylindrical shells. He excelled in statics and dynamics and had an uncanny judgment as to stresses and flow of forces. He was most productive in coming up with new systems in design and construction technologies. His love of engineering was reflected in his inspired contributions. Always present in his mind was this question: "How can it best be built?"

Dr. Finsterwalder demanded as much of himself as he did of others; at the same time, he was personally modest and pleasant to work with. Coworkers and those who worked under him considered it a privilege to be involved in his efforts, were constantly astonished by how prolific he was, and marvelled at his inventiveness, stamina, and tenacity. He was a great teacher, judging the work of others fairly. He spoke out against low-quality work and wasteful and poorly conceived solutions.

He has left behind his imprint on millions of square feet of long-span concrete shell structures as well as hundreds of bridges in many nations. His first major shell structures, the Great Market Halls of Frankfurt, Budapest, and Cologne, were built in the 1930s. Long-span airplane hangars followed. His first major prestressed concrete spans over the Rhine River at Worms were built in 1953. Bridges in central and southern Europe followed. One of his favorite designs was the spectacular Mangfall Bridge that, like the Brooklyn Bridge, was designed so that pedestrians can walk through the structure. His Bendorf Bridge (1964) over the Rhine River, a 4,000-foot prestressed concrete crossing with a main span of 682 feet, served as the textbook for later structures of this kind. The span was a record at that time but soon thereafter was exceeded by the 754-foot Urado Bridge in Japan.

In Japan alone, there were more than one hundred bridges built prior to 1973 that were based on Finsterwalder's designs and construction techniques. His lectures in the United States in the mid-1960s led to numerous other such structures in California, Hawaii, and Canada.

In recent years he was involved in numerous studies of major bridges and tunnel projects, including proposals for crossings of the British Channel, the Bosporus, and the Strait of Messina. He was pleased when at age ninety he was appointed to the multigovernment planning board for the proposed Brenner crossing of the Alps. Also in 1988 in a joint venture with a New York City firm, he participated in a proposal for a new 1,600-foot suspension span to replace the Williamsburg Bridge in New York. Dr. Finsterwalder was also a consultant in the early planning for Florida's Dame Point Bridge, a cable-stayed span that established the U.S. record at 1,300 feet.

Ulrich Finsterwalder's honors and awards were many, and they came from governments, engineering groups, and educational institutions throughout the world. His first American award, the Longstreth Medal of the Franklin Institute of The Commonwealth of Pennsylvania, came even before World War II. In addition to honorary membership in the American Concrete Institute, he was accorded the Institute's Charles S. Whitney Medal in 1967 for "distinguished contributions to the engineering development of concrete shells and prestressed bridges."

He was the first bridge engineer to receive the International Award of Merit from the International Association for Bridge and Structural Engineering (1977) and was also the first non-American structural engineer to be elected a foreign associate of the National Academy of Engineering of the United States (1976).

Other honors included the Inventor's Prize of Honor of the German Federal Republic, the Great Cross of Merit also of Germany, the Fritz Schumacher Prize of the Senate of the City of Hamburg, the Emil Morsch Medal of the German Concrete Association, and the honorary membership in the British Concrete Society. He was elected an extraordinary member of the Academy of Fine Arts in Berlin and received honorary doctorates of the universities at Munich and Darmstadt, the Carl Friedrich Gauss Medal, the Gustave

Magnel Gold Medal of Belgium, and the Freyssinet Medal of the International Federation for Prestressing. He held nearly twenty patents on his inventions and authored more than eighty technical papers including some on specialized subjects, for example, self-stressing trusses or a slipform-constructed, suspended floating underwater bridge (a tunnel).

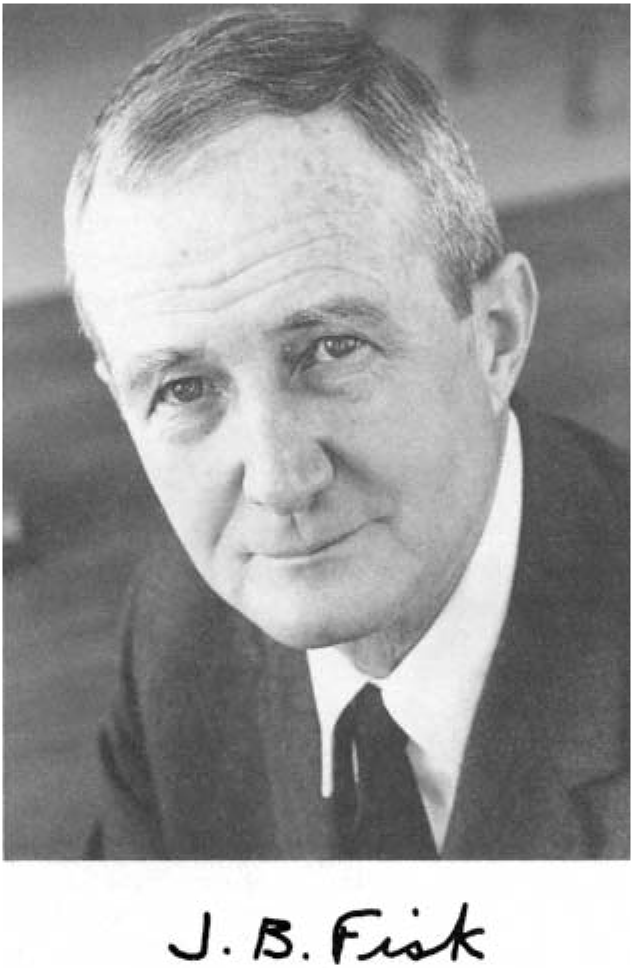
His love and devotion to his family were outstanding. In the days that followed World War II, food shortages were not uncommon in devastated Germany, and the Finsterwalder family was not alone in their needs. As a result, Ulrich made frequent nightly trips on foot across the mountains into Austria in order to bring back food for his family.

Such crossings were forbidden and violators were threatened with the death penalty. On one occasion Ulrich was arrested by a border patrol guard, but speaking to the man as a priest would have talked, he convinced the guard that the moral law of a father and a husband was stronger than the rules of military occupation authorities. The guard let Finsterwalder escape.

Those postwar days resulted in Finsterwalder's purchase of a cow, and this led to his interest in farming. A family-owned large dairy farm was the outcome of this, and Finsterwalder's ingenious mind was in evidence even in this endeavor; for example, the cow barn was a concrete shell.

His family included his wife, Eva; three sons, Klemens, Lorenz, and Thomas; two daughters, Ruth and Renate; and twelve grandchildren. Three of the children have doctorate degrees in engineering or science. Thomas, the youngest, also a Munich engineer, holds the world record in hang-gliding. The Finsterwalder name is known not only for imaginative bridges designed by the father but also for the hang-gliders researched, designed, and built by his son Thomas.

When death came in a Munich hospital, he was surrounded by his family. His last words to them were "Love is the most important foundation of our existence."


J. B. Fisk

James Brown Fisk

1910-1981

By William Baker

James B. Fisk, a principal figure in the joining of modern physical science to technology on behalf of the telecommunications industry and national security in the electronics, atomic, and space eras, died in Elizabethtown, New York, on August 10, 1981. He had retired as chairman of Bell Laboratories in 1974, having served as executive vice-president from 1955 and president from 1959. The eighteen years in which he was thus directly responsible for all technical programs pursued by Bell Laboratories for AT&T and its Bell System also included major sensor and information work for the Department of Defense, the organization and operation of Bellcomm in support of the national Apollo lunar exploration, and close affiliation with the Sandia Laboratories in nuclear systems research and engineering. He was especially admired for the ways in which he joined the keenest of minds to a warm-hearted regard for his associates and friends, and brought wit and humor to positions of high authority and challenging responsibility.

James Fisk's father was in business in Rhode Island when he moved his wife and family to Tacoma, Washington, where the children's early schooling was interruped by the untimely death of Mrs. Fisk. Her parents persuaded the family that the children should return and pursue their schooling in Providence, Rhode Island.

In 1927 Fisk enrolled in the Massachusetts Institute of Technology (MIT). With an especially strong instinct for mechanisms and the engineering base of invention and creativity, Fisk's undergraduate concentration was in the new pursuits of aeronautical engineering. Further, he had come to know Professor Charles Stark Draper, who was then just beginning his lasting role at MIT. Also, in addition to his technical high school experience, Fisk was much impressed by Professor Taylor in mathematics, a field which appealed to him more strongly than the relatively descriptive (and pre-quantum theory) physics and chemistry as they were then taught. Likewise, as Fisk came to know Draper and his work in more depth and became his assistant in the engine laboratory, he noticed that the physical sciences were being animated at MIT through the leadership of the new president, Professor Karl Compton (from Princeton). Accordingly, this especially decisive period in Fisk's growth involved a remarkable combination of his early and innate interest in engineering, which was expertly fortified during the MIT undergraduate years and by the influence of Draper, and the oncoming era of quantum mechanics and atomic and molecular structure. For the latter, Draper recognized the young Fisk's strong potential, and urged him to learn more about this new wave of study of matter and energy. Fisk enrolled in one of James Slater's earliest courses in theoretical physics and caught the excitement of the new fields. Then receiving the Redfield Procter Traveling Fellowship in 1932, he went to Cambridge University where he worked with those who were probing the nucleus, the atom, the particle, and thinking about the new shape of natural science.

On his return to MIT, Fisk was fully involved in modern physics and qualified for the Ph.D. general examination without taking the traditional extended course work. He then undertook research with Professor Philip Morse on collision cross-sections of diatomic gases when bombarded with electrons.

Fisk served from 1936 to 1939 as a junior fellow at Harvard.

After working on particle accelerators and an electrostatic generator at Harvard, and with further work at MIT, he accepted a job on the faculty of physics at the University of North Carolina.

In 1939 Bell Laboratories, a separate corporation in the Bell System wholly owned by the AT&T Company and the Western Electric Company, sought to add cautiously to its technical staff. This was part of the evidence of preparing for the future that led Dr. James Fisk to accept the invitation of Mervin Kelly to join Bell Laboratories. For what was being sought was, of course, a new direction of science and technology, recognizing what the era of electronics might mean in the business of telecommunications. Although these prospects were soon to be perturbed by a world at war, the goals remained and the work toward them was only delayed.

So the original excitement of the new electronics in 1939 had to be deferred for more than six years, when all Bell Labs' efforts were converted to the development of resources in defense of the nation. But Fisk's intrinsic capacity for leadership soon emerged in the radar work to which he was assigned. In collaboration with Paul Hartman and Homer Hagstrum, Fisk fully exercised the remarkable abilities for joining engineering and scientific theory. In little more than sixty days of intense design and development, this group brought to production, for a host of vital wartime systems, precise wave generators reaching eventually into the 3-centimeter and 1.25-centimeter wavelength region.

Jim Fisk's effective conduct of the wartime work, for which he received the Presidential Certificate of Merit in 1946, also provided occasion for his broader and lifelong interest in public service. He collaborated with William Shockley in the independent derivation of conditions for the critical mass and sustained chain reaction of an atomic pile. These studies convinced Fisk of the dramatic recasting of world peace and stability implicit in the production of atomic weapons as well as in the potential of nuclear energy generally.

He was, in 1947, appointed the first director of research of the U.S. Atomic Energy Commission.

Because he had become a valued friend, collaborator, and adviser of the leading scientific and engineering personalities of the time, he was uniquely prepared to work with President Eisenhower and James Killian in the formation of the Office of Science and Technology in the White House in the late 1950s. He served as vice-chairman of the President's Science Advisory Committee from 1957 to 1960 and as consultant from 1960 to 1973. In 1958-59 he was chairman of the U.S. Technical Delegation to the Geneva Test Ban Conference with the Soviets. In the protracted 1959 discussions on tests and verifications of nuclear weapons development, he foresaw and introduced many of the scientific and engineering issues that remain central today in arms limitation and disarmament negotiations.

Concurrent with these notable undertakings was, of course, the renewed interest in the earlier visions of Kelly and others of the future of telecommunications. The Laboratories' administration proposed in 1946 a prominent role for Fisk as assistant director of Physical Research.

In this context Fisk immediately applied his enthusiasm for recruitment of genius and, likewise, set up special links to the Chemical Laboratories and other sections of the research area. These efforts were accompanied by seminars and conferences generated originally by Shockley, in which we drew together the many new streams of science coming from preware Europe and especially the United Kingdom and the postwar science and technology of the United States. With Fisk's special new direction, connections were established with universities worldwide. As a result, the Laboratories' science and engineering staff, through these connections, recruited directly rather than through the conventional routes that industry had followed of Personnel Department mediation. We arranged a network throughout the Bell Laboratories' engineering and scientific organizations that was responsible for this vital acquisition of gifted graduates. Fisk was an ardent supporter of this strategy from its inception.

Naturally, these strong sensibilities about human abilities coincided with Fisk's inclination to academic communities and enterprises. After deep consideration and consultation with his family, wife Cynthia whom he married in 1938, and sons Samuel, Zachary, and Charles, Fisk accepted in 1947 an appointment as Gordon McKay Professor of Applied Physics at Harvard. As noted, he was immediately diverted to his post in the Atomic Energy Commission, but did return to Harvard to teach until 1949. Then he was again persuaded by Kelly and Ralph Bown, the director of research at Bell Laboratories, that the opportunities and challenges there matched Fisk's basic career goals. Fisk returned in mid-1949 to the expanded Murray Hill headquarters.

Kelly and Bown had revised the organization of the Research Department to accommodate new frontiers that we saw taking form, and where the invention of transistors in 1947-48 had affirmed the onset of an era of solid-state science and engineering that would, as the century advanced, be the base for an information communications age.

Ralph Bown was an unsurpassed sponsor of this, bridging as he did the productive, classical times of radio carrier cables and early microwave technology with a keen and perceptive appreciation of the wave/particle potentials of solid-state physics, chemistry, and metallurgy. These fields were encompassed in the new organization by the Division of Physical Sciences, of which Fisk became the executive director. He moved to vice-president of research in 1954. Already it was evident that Fisk's early, deep interest in engineering applications and expression of new knowledge in makeable and useable operating systems would be broadly exercised in the integrated Bell Systems. Accordingly, in 1955 he was elected executive vice-president in charge of all scientific and technical programs at Bell Laboratories.

He demonstrated then, as later, adept and enthusiastic liaison with his associates in administration and in scientific and engineering performance. This cooperation was built around encouraging and expecting these contemporaries to work as individuals—to work for the advancement of the institution and the community but to take individual initiatives and responsibilities. He would not allow some amorphous shifting of the load to an undefined institution. Rather, each of Jim's associates and friends knew everyday and in every way his expectations of individuality of task.

Returning to Bell Labs as the discovery of the transistor was opening a new realm of communications computing and information handling, Fisk soon became a leader in realization of Kelly's and Bown's aspirations to pursue Shockley's convictions about the electronics of solids. The challenge of rapid application of research that Fisk promoted and assured was reflected in development response to such findings as the crucial oxide masking process of treating thin films of silicon. This was preeminent in the production of semiconductor devices and circuitry for the next twenty-five years. Along with initiation of epitaxial growth in 1960 and preparing for the thin-film integrated circuitry at the frontier of semiconductor systems in the 1980s, research findings of the solar battery, and advanced traveling wave tubes and solid-state parametric amplifiers and masers paved the way for the experiments of the Echo passive communications satellite of 1960 and its successor, Telstar, a couple of years later.

Fisk also pursued with Kelly, and onward into his own administration of the 1960s and early 1970s, transfer of the new materials science and engineering into much of Western Electric manufacturing and the Laboratories' product designs. An example was the substitution of synthetic polymer sheathing for traditional carrier, exchange, and other cable construction—a move that was later said to have saved, in cost of the expanded Bell System plants, more than the cost of the total research budget of Bell Labs for the decade in which the innovation was worked out.

Likewise, Jim Fisk was alertly sympathetic to the wide theoretic and operational significance of mathematics research. A range of actions during that period, such as the creation of the first transistorized digital computer, the TRADIC, for a government contract at the Laboratories, heightened Fisk's understanding that the new transistorized/digital era would be not only revolutionary for information and communications but also for national strategy and the economy generally.

As noted, he served in the White House Science Office during this period, and in the 1960s was a member of Presidential committees to conduct technical missions to Europe and Asia. As a member of the board of overseers of Harvard from 1961 to 1967 and for twenty-two years on the MIT Corporation, being on the executive committee from 1959 to 1978, he maintained close connections with leaders in academic and government communities.

He was also an active member of the National Academy of Sciences; founding member of the National Academy of Engineering; trustee of the John Simon Guggenheim Memorial Foundation, the Alfred P. Sloan Foundation, the Sloan-Kettering Institute for Cancer Research; member of the American Philosophical Society; and a fellow of the American Physical Society and the Institute of Electrical and Electronics Engineers.

As a result of his endeavors on behalf of industry, academia, and government, he received honorary doctor of engineering degrees from the University of Michigan (1963) and the University of Akron (1963); and doctor of science degrees from Carnegie Tech (1956), Williams (1958), Newark College of Engineering (1959), Columbia (1960), Colby (1962), New York University (1963), and Rutgers (1967). These were augmented by honorary doctor of laws degrees from Lehigh (1967) and the Illinois Institute of Technology (1968).

Jim Fisk's patriotism showed up in ways outside even his unexcelled role in national defense and in the building of a new American telecommunications network. Jim took the lead in working out a response to requests from the White House and the National Aeronautics and Space Administration that the Bell System set up an engineering cadre to assist the moon landing program. This required a good deal of rearrangement, among the Bell System's research development groups, that resulted in Bellcomm.

But overarching these activities was his steady effort in Bell Labs for technical and operational gains for the AT&T Bell Telephone System. In switching, the pioneering #1 ESS and 2A ESS, international dialing, and new traffic service systems; in transmission, new carrier, microwave transocean (4,000 miles with 845 two-way voice channels), and satellite systems; in telephone terminals, call distributors, data sets, mobile radio, and answering units, all were among new products developed. Some thirty-three "expert systems" of computer software were created for advancing telephone system reliability and efficiency.

Recognition of these accomplishments, which affected so much of the technical and engineering base of the last half of the century, took many forms. These included among others the Medal of the Industrial Research Institute in 1963, being voted an "outstanding citizen of New Jersey" citation that same year, the Washington Award of the Western Society of Engineers in 1968, the Advancement of Research Award of the American Society of Metals in 1974, the Hoover Medal in 1975, and also in 1975 the Founders Medal of the National Academy of Engineering.

As our nation seeks now to revive and extend excellence in citizens' thought and action, we are grateful to have had the model that Jim Fisk embodied. The pride he took in the 1975 establishment of James B. Fisk Scholarships, annually awarded to children of members of Bell Laboratories, and in the successes of his family are samples of the enduring themes that carry onward his quest for quality.

Daniel W. Fox

1923-1989

By John F. Welch

In December of 1988, weak and sick with the cancer that would claim his life less than two months later, Dan Fox, a legend in the plastics industry and a founding father of the $5 billion General Electric (GE)-engineered materials business, made yet another exhausting trip to Tokyo to inspect a new process for producing the Lexan polycarbonate resin he had invented over thirty years before. It was to be his last trip, but by no means the end of his quest for the perfect material, which continued in the animated technical conversations he had with his saddening friends until the day he died.

I was a recent chemical engineering graduate on the job interview circuit when I met Dan in 1960 at a GE plant in Pittsfield, Massachusetts. They brought me in, late in the day, to meet a fellow doing chemical research who, it was claimed, had some ideas about new plastics. By early evening I was a goner, infected by his enthusiasm, enthralled with his ideas, and impatient to work for him. It was the first, and one of the few times I ever met a man who could not, or would not, savor his triumphs. As soon as he completed one of his many inventions, he would shift from passionate advocate of his work to devil's advocate, criticizing its thermal characteristics, solvent resistance, hardness or whatever, and jumping into the hunt once again for a better plastic. I met him shortly after he had invented Lexan, yet he exhibited none of the pride even the most modest of men allow themselves over a recent achievement. If anything, he criticized the shortcomings of the plastic even as the world was beginning to celebrate its virtues. He wanted, instead, to talk about the next project, in this case a polyether polymer resin, which culminated in yet another GE plastic—Noryl.

This cycle repeated itself over and over, with GE following eagerly in his wake to market his creations. Dan was a scientist, not a marketing man in the professional sense, although qualities desirable in the marketplace were always the goals of his experiments. He was, however, one of the best salesmen I've ever seen when it came to squeezing another million or two out of tight-fisted bosses for the facilities and equipment to pursue his quests. I vividly remember him coming to budget reviews with bulging pockets, into which he would reach periodically to pull out a chunk or strip of plastic that illustrated some characteristic he was in a fever to explore.

He was inquisitive beyond measure, and his curiosity led him up unlikely paths that often yielded astonishing rewards. The discovery of Lexan was one of them, and its story has become a legend at GE.

Lexan was created shortly after Dan joined the company in 1953 after earning an M.S. and Ph.D. at the University of Oklahoma. Scientists at the GE Research and Development lab were tantalizingly close to developing a better thin film insulating material for wire, but every material that served the purpose deteriorated when exposed to water. Dan recalled a substance called guiacol carbonate that had frustrated him in graduate school precisely because of its resistance to being broken down by boiling water. When he mixed it with other ingredients as a possible solution to the wire coating problem, he got what he called a "glob" of material so hard he couldn't remove his stirring rod from it. By then the wire coating problem had been solved by other means, and the curious glob was kept around the lab like an inanimate mascot, occasionally used to drive nails, sometimes thrown down stairwells in futile attempts to make it break, until its unique properties began to provoke increasing curiosity, and then excitement. The world's best-selling high-performance engineered plastic had been born, and within a few years it had begun to appear in computer housings, automobile bumpers, baby bottles, football helmets, and countless thousands of other applications. But by then Dan was three or four plastics down the road, pausing only long enough to get, as he put it, "a big kick", when astronauts wearing "fishbowls" of his Lexan landed on the moon in 1969. In a world full of people who come out for a third or fourth bow, he was ever impatient to get on with the next act.

During Dan's thirty-six years with GE Plastics, he compiled an astonishing record of inventions, achievements, and honors. His forty-fifth patent was filed a month before his death. The plastics that he invented, coinvented, or helped perfect include, besides Lexan, Noryl, the commercial version of a polyether polymer; polybutylene terephthalate, commercialized as Velox resin; Alkanex wire enamel; and several others. His other work focused on polymerization processes, and he wrote the first book on polycarbonates in 1962, one of the earliest of his twenty major technical publications.

Dan was inducted into the Society of Plastics Industry Hall of Fame in 1976, and became its youngest living member. He was inducted into the National Academy of Engineering in 1984, and in 1987 he was presented with the Midgely Award by the American Chemical Society for outstanding chemical research relating to the automotive industry. Around GE he is commonly referred to as the "Father of Lexan," but he was, in fact, the scientific father of the entire business, which is now number one in the world. His genius, centered in polycarbonates, included most areas of polymer chemistry.

I have many fond personal memories of Dan—decades worth—but some of the best were in the 1960s, whenever we could drag him out of his laboratory and experience the warmth, the humor, and the graciousness of the man and visit with him and his wonderful wife Joyce, who never got to see enough of him. Their home was the gathering place for young engineers and scientists, always gaily decorated at Christmas, filled with terrific food, and the scene of many long and pleasant evenings. It was a treat for us to be in his company, as if in doing so we might absorb some of his brilliance.

Dan wasn't the world's greatest manager. He was shy. He never had a bad word for anybody, certainly couldn't fire anyone, and was bored with the paperwork that went with management; but he was as aggressive and confident in the lab as he was unassuming and diffident outside it. His great personnel talent was in the hiring and professional cultivation of scientists. Scores of us proudly call ourselves graduates of "Fox U."

Glen Hiner, who runs our plastics business, tells of visiting Dan a day or two before his death. Punctuating his customary harangue about technical issues and challenges, and how they should be dealt with, were frequent prideful references to his newborn grandson, a picture of whom he kept on a table next to his bed, where he could see it. His affection for the boy knew no bounds, and it was so typical of him that, at a time when most men would stop to reflect on the past, on a lifetime of achievement, in his grandson he was looking toward, and loving, the future.

On February 15, 1989, my old friend and mentor, Dan Fox, passed on. This nearly perfect man, ever in search of the perfect plastic, finally found a perfect rest.

He will never be forgotten at GE.

Richard S. Frank

1914-1986

By Gordon H. Millar

Richard S. Frank, a leading international mechanical engineer, director of research and engineering for Caterpillar Tractor Company, and a member of that company's senior executive staff, died on August 23, 1986, at the age of seventy-two.

From 1936 until his retirement in 1976, Dick Frank was a major motivating force in the development of heavy equipment technology that contributed to the Caterpillar Tractor Company becoming the world's premier heavy equipment manufacturer. The technology and the products for which Dick Frank was responsible are recognized throughout the world by their distinctively rugged design, their impeccable reputation for reliability, and for the corporate support structure that makes service available for Caterpillar machines wherever they are used.

There is no place in the world that people may travel where they have not been preceded by Caterpillar equipment ranging from the conventional crawler dozer used in the grading of roadways to the giant earthmoving machines and ore trucks that make the mining and transportation of earth's resources a practical and economically attractive activity. The distinctive Caterpillar yellow is generic to the earthmoving equipment industry, and the word "Caterpillar" is synonymous with track-laying vehicles worldwide, no matter who their manufacturer.

The Alaska pipeline was built almost exclusively by Caterpillar machines. These same machines do their yeoman work not only in the Western world but also in the Soviet Union, Near East, China, South Africa, and South America. These machines and the technology that made them possible are the legacy Dick Frank leaves with the engineering community and also wherever a niche of civilization has taken root, even in parts of the world with the most hostile climates.

Dick Frank lived his entire professional life until his retirement years in the Middle West industrial heartland of our country. He graduated from Washington University in St. Louis with a B.S. in mechanical engineering and joined Caterpillar that same year. He became in succession a designer, supervising engineer, and general supervising engineer and was appointed assistant chief engineer of engine design in 1953.

In 1956 Dick Frank became assistant chief engineer of tractor design and seven years later was named chief engineer of the Joliet plant, serving in that capacity until April 1966. That year Dick Frank was appointed assistant director of engineering for all Caterpillar operations worldwide and in November of the same year was named director of engineering.

Dick Frank was elected a vice-president of Caterpillar in October 1970 and in that capacity directed all technical operations worldwide for research, design, and manufacture.

Dick Frank retired October 1, 1979, after forty-three years of continuous service and technical contribution to Caterpillar and the heavy equipment industry.

A major challenge in the later years of Dick Frank's active leadership was guiding Caterpillar technology to parry the thrust of heavy equipment producers from Europe and the Asian countries. Through Dick Frank's effective leadership, the Caterpillar organization met the competitive challenge head-on, and today remains the recognized leader of heavy equipment manufacture throughout the world. The advanced product technology, development of advanced manufacturing techniques, continued development and recognition of employee skills, and the astute management of corporate assets places Caterpillar Tractor Company in the unique position of remaining a dominant North American force in the production of heavy equipment worldwide and an ongoing factor in making a positive contribution to the balance of trade for the United States.

Richard S. Frank was an active member of the Society of Automotive Engineers and one of the founders with G. Edwin Burks of the Earthmoving Conference in Peoria, which is recognized throughout the world as the single most important technical conference devoted to the heavy equipment industry. Richard Frank was also a fellow in the American Society of Mechanical Engineers and a director of the Lubricant Review Institute Board. It was through his work at the Caterpillar Tractor Company that definitive standards were established to measure the quality of lubricating oil for use in heavy duty diesel engines associated with the heavy equipment industry.

Richard Frank was active in community affairs, a member of the Peoria Chamber of Commerce, and a director of the Riverfront Action Forum of the Tricounty Planning Commission in Central Illinois. He was involved with Bradley University in Peoria and developed a close working relationship between Bradley and the Caterpillar Tractor Company that provided for a free exchange of information between the local academic world and industry.

Despite his intense corporate posture and his focus on manufactured products, Richard Frank never forgot that without solid academic engineering training, the world of manufacturing would not move forward. He maintained close associations with local universities and was recognized throughout the community not only as a successful corporate executive but also a human being of broad social understanding and intellectual skills. He was an avid tennis player and pursued the sport of tennis with the same intensity as he pursued his career.

Richard Frank was elected to the National Academy of Engineering in 1980 as one of a very select group of engineers from the heavy equipment industry to become members of the Academy. The recognition on the part of his peers that his contributions to the world in which we live warranted his election pays lasting tribute to his effectiveness as an engineer, his statesmanlike quality as an administrator, and his recognized intellectual depth. Dick Frank's memory stands as a monument to all industrial executives and engineers of what can be accomplished in industry with the proper application of intellectual and practical effort.

Dick Frank is survived by his wife, Martha, three delightful daughters, and three grandchildren. His memory remains with all of us in the profession, and he will be remembered forever by his family and all of us who were his friends as a talented engineer, a superior executive, and a kind, warm, and thinking human being.

The squadrons of powerful machines that daily make the world a better place to live are Dick Frank's contribution to an ever-expanding civilization to be enjoyed by world populations for many years.


G. Gabrielli

Giuseppe Gabrielli

1903-1987

By Nicholas J. Hoff

One of the greatest airplane designers of Italy, Giuseppe Gabrielli died in his adopted home town of Turin in northern Italy on November 29, 1987. Born on February 26, 1903, in Caltanissetta, Sicily, Gabrielli was a southerner, but he moved north to study aeronautical engineering under Professor Panetti at the Polytechnic Institute of Turin. Except for short periods of time, he remained in this great industrial town for the remainder of his life, designing airplanes at Fiat and teaching airplane design at the Polytechnic.

From the Polytechnic Institute of Turin he went to the Technical University of Aachen in Germany to continue his studies under the direction of Professor Theodore von Kármán; the warm friendship that developed between the two outstanding men lasted until the death of von Kármán in 1963. The Polytechnic of Turin conferred on Gabrielli the diploma in mechanical engineering in 1925, and the University of Aachen the doctorate in aeronautics in 1926.

In 1927 Gabrielli was appointed instructor of aircraft design at the Polytechnic Institute of Turin and was promoted to full professor in 1949. He remained there until the retirement age of seventy, teaching and doing research; one measure of his academic activities is 150 technical papers published.

Almost simultaneously with the beginning of his academic career, Gabrielli received an industrial appointment, becoming assistant to Chief Designer Giovanni Pegna at the Piaggio Company in Genova. His assignment was the development of metal airplane structures; he had studied these in Aachen and they were also being adopted in the United States at that time. But Gabrielli did not give up his teaching; although he was living in Genova, he commuted one day a week to Turin to give his course at the Polytechnic.

The first great success of the young engineer was the redesign of the Savoia-Marchetti S.M.S. 55 flying boat in aluminum alloy; the original wood S 55 became famous when several squadrons of it crossed the Atlantic in formation under the command of General Italo Balbo in the 1930s. Gabrielli's metal structure had an ultimate load factor of 9 against the 7 of the original wood structure, yet it was 1,168 pounds lighter.

This achievement caught the eye of Giovanni Agnelli, the almost legendary founder-director of Fiat, the largest industrial concern of Italy. In 1931 he appointed the twenty-eight-year-old Gabrielli manager of a new department of the company. In this department Gabrielli developed a total of 142 airplanes of which 63 were manufactured and 17 mass-produced. Among them were the G 50 of 1939, the first Italian aluminum alloy monocoque monoplane fighter; its successor, the outstanding G 55 of 1943, which reached a high speed of 385 miles per hour but appeared too late to have an influence on World War II; the G 80 of 1951, the first Italian jet fighter; and the G 91, which won the North Atlantic Treaty Organization (NATO) fighter competition of 1957.

When in a reorganization of the Italian airplane industry Fiat gave up the manufacture of aircraft, Gabrielli continued his work for the company practically until the end of his life as chairman of the board of Fiat Aviazione, a builder of airplane engines in Turin.

Gabrielli was very much involved in the activities of national and international organizations in aeronautics. He was Italian delegate to the Advisory Group for Aeronautical Research and Development of NATO; member of the International Council of the Aeronautical Sciences (Paris); president of the Association Internationale des Constructeurs de Matériel Aérospatial (Paris); member of various committees of the National Research Council (Rome); vice-president of the Italian Navigation Institute; corresponding member of the Deutsche Akademie de Luftfahrtforschung and of the International Academy of Astronautics (Paris); honorary fellow of the Royal Aeronautical Society (London), and honorary member of the Société des Ingenieurs de l'Automobile (Paris) and of the Association Française des Ingénieurs et Techniciens de l'Aéronautique et de l'Espace (Paris). He held membership in the American Institute of Aeronautics and Astronautics and the Deutsche Gesellschaft für Luft-und Raumfahrt. Gabrielli was corresponding member of the Deutsche Akademie der Luftfahrtforschung, member of the Flight Safety Foundation (New York), member of the board of directors of the Aerospace Industry Association (Rome), and member of the Daniel Guggenheim Medal Board of Award.

Gabrielli was elected a foreign associate of the U.S. National Academy of Engineering (NAE) in 1983.

Among the major honors bestowed on Gabrielli were the Ludwig Prandtl Ring, the highest honor in aerodynamics in Germany; the knighthood of the Légion d'Honneur (France); and the knighthood of the Grand Cross of the Order of Merit of the Republic of Italy.

Gabrielli is survived by Lydia, his wife of fifty-one years. Through her he was a member of the most famous family of Italian aeronautical engineers, as his father-in-law was General Arturo Crocco, who had published papers on the theory of flight and built airships before World War I, and his brother-in-law was Luigi Crocco, a great expert on aerodynamics and rocket propulsion. Luigi was a foreign associate of the NAE, and his biography was published on page 101 of Volume 3 of these *Memorial Tributes.*


Eric T. B. Gross

Eric T. B. Gross

1901-1988

By Gregory S. Vassell

Eric T. B. Gross, an internationally renowned electric power engineer, author, and educator, died on June 27, 1988, at his home in Schenectady, New York, at the age of eighty-seven. At the time of his death, he was Philip Sporn Professor Emeritus of Engineering at Rensselaer Polytechnic Institute (RPI) in Troy, New York.

Eric Gross was born in Vienna, Austria, on May 24, 1901. After completing his secondary education, he studied electrical engineering at the Technical University of Vienna. Upon graduation "with distinction" in 1923, he embarked on his professional career by finding employment in industry. In 1924 he joined the Union Electric & Manufacturing Company (A.E.G.) in Vienna, Austria. While working as a practicing engineer, he continued his studies at the Technical University of Vienna, receiving a D.Sc. "summa cum laude" in 1932. In 1938 he moved to England, accepting a position as consulting transmission engineer with the A.E.G. Electric Company, Ltd., London.

When Eric Gross arrived in the United States in 1939, he already had earned an international reputation as a distinguished electric power engineer. By that time he had contributed significantly to major advances in high-speed relaying and to lightning protection and grounding of high-voltage transmission networks, and had published extensively in technical journals in Austria, Czechoslovakia, Germany, France, Switzerland, and the United Kingdom.

After a short stint as an instructor in electrical engineering at the City College of New York and a three-year appointment as assistant professor at Cornell University, Eric Gross joined the faculty at the Illinois Institute of Technology (IIT) in 1945 as professor of electrical engineering. He remained at IIT for seventeen years, establishing at that school the nation's first graduate program in electric power engineering. Over the years, he nurtured this program to a level of excellence that attracted international recognition.

In 1962 Eric Gross came to RPI to become its Philip Sporn Professor of Electric Power Systems Engineering and to found the nation's second graduate program in electric power engineering. The program started with only two full-time graduate students. By the time Professor Gross retired in 1973, he had increased the enrollment to sixty full-time graduate students (all supported by fellowships). In the process, RPI emerged as this country's most prominent graduate school in electric power engineering.

Throughout his career as an educator, Eric Gross remained active as a *practicing* engineer: he maintained close ties with the industry; he was a registered professional engineer in Illinois, New York, and Vermont and a chartered electrical engineer in the United Kingdom; he authored or coauthored more than one hundred technical and scientific papers published in professional journals around the world; he held twelve patents dealing with his inventions in the field of electric power systems protection and grounding; and he served as consultant to several major electric utility companies, equipment manufacturers, and government agencies.

Eric Gross was also generous of his time in participating actively in the work of many professional and academic organizations, such as the Institute of Electrical and Electronics Engineers (IEEE) (and its predecessor organization, the American Institute of Electrical Engineers), American Society for Engineering Education, American Power Conference, Pan American Congress on Engineering, and the International Conference on Large High Voltage Electric Systems (Paris). He served on numerous committees of these organizations, either as a member or as an officer. He served as the national president (1953-54) of Eta Kappa Nu (electrical engineering honor society) and was a member of Tau Beta Pi (engineering honor society) and Sigma Xi, The Scientific Research Society.

Professor Gross has not lacked formal recognition for his many accomplishments in the art and science of engineering, both as a distinguished practicing engineer and as an outstanding engineering educator: he was elected a fellow of the IEEE, the Institution of Electrical Engineers (London), the New York Academy of Sciences, and the American Association for the Advancement of Science; he was elected a life patron of RPI by its trustees; and he received numerous awards, medals, and citations from a variety of professional and educational institutions.

In 1978 Professor Gross was elected to the National Academy of Engineering for "contributions to electric power system education and pioneering leadership in the development of international educational programs." In 1979 he was awarded the Austrian Cross of Honor for Science and the Arts, First Class, for his career achievements in the field of electric power engineering.

Throughout his life, Eric Gross was a fighter for what he believed in: excellence in engineering, proper balance between theory and practice in engineering education, and preservation of electric power engineering as an essential engineering discipline on U.S. campuses. He held strong views and was prepared to work and fight for them with dedication, tenacity, and courage.

He entered upon the stage of engineering education in the United States during a stressful period, when—during the 1950s and early 1960s—the predominantly practical orientation of the past was being replaced by emphasis on theory and research. In this process, electric power engineering was getting short shrift on many U.S. campuses and, in fact, was heading for complete extinction. Many engineering educators of that day thought that there were no new insights to be found in the electric power field and no new challenges to be offered in that area to the inquiring minds of young men and women. Professor Gross strongly disagreed. It was in this context that the success of his graduate programs in electric power engineering at IIT and RPI contributed mightily to the preservation of electric power as a field of intellectual challenge for new generations of electrical engineers. Following his example, and through efforts of like-minded educators and industry leaders, some twenty new undergraduate and graduate programs in electric power engineering were established on U.S. campuses during the 1960s.

Eric Gross occupies a very special place among engineering educators. He was a teacher of exceptional talent—an "old world" professor right out of a storybook. His teaching was clear and precise, with a fine blending of theory and practice. He was demanding of his students, yet also supportive of their efforts and free with his praise of good work. He developed strong personal bonds with most of them by showing genuine interest in their careers, and even in their personal lives. This unique relationship continued after a student's graduation. Professor Gross helped his students find jobs of challenge and opportunity and "Eric's boys" were always in high demand by industry. When one of them became a manager, as often happened, Professor Gross would expect him to help assure proper placement and career development for his new crop of graduates.

Students revered Professor Gross. Over the years, many of them achieved distinction of their own in various branches of electric power engineering. Throughout their careers, however, they all remained his "boys." Their feelings toward Eric Gross are well expressed in a comment by one of his former students, who is now a distinguished engineer in his own right as president of an important consulting firm in the energy field:

> I spent only one year under Eric before finishing my studies. Later in life, our paths crossed many times. He never once wavered from his dedication to the education of top quality electric power engineers. I will never forget him and the great good he did me, professionally and personally. Nor will I forget the standard of excellence he led me to expect of myself and of others.

Jozsef Hatvany

1926-1987

By Francis W. Boulger

Dr. -Ing. Jozsef Hatvany, pioneer and outstanding leader in the field of computer-integrated manufacturing systems, died after a long illness on July 11, 1987, in Budapest. For the preceding seven years he had been senior scientific adviser to the director of the Computer and Automation Institute of the Hungarian Academy of Sciences.

Dr. Hatvany made notable contributions to progress in the field of sensors, computer programming, and machine tool controls. By generous cooperation with specialists in other countries, he greatly advanced international progress in computer-integrated manufacturing systems. He was a leading force in the early implementation of such systems in Hungary.

Born in Budapest on November 18, 1926, to a prominent family with a long intellectual background, Dr. Hatvany received a broad education, mainly in Britain between 1938 and 1947, and studied physics at Trinity College at Cambridge. On his return to Hungary he taught philosophy at the University of Budapest but was soon arrested by the Stalinist authorities, and in the jail he founded a group to work on advanced mechanical engineering. After his rehabilitation he joined the academic groups that started to develop computer science and technology in Hungary and to establish new relations between computers and the mechanical engineering traditions of the country. His research and development work in the 1960s was concerned with sensors and feed-back devices for digital control, and with industrial applications of systems for digital path-control of machine tools. Digital interpolators for numerically controlled machine tools also received attention. That early research by Dr. Hatvany and his colleagues bridged the gap between the numerical control (NC) of machines and the incremental or pulse technique needed to implement systems. The group developed the first successful continuous-path NC contouring unit in Eastern Europe. That effort was followed by the development of programming languages, and the graphic display software and equipment needed for electronic NC program controls. Although that development work was described by Hungarian-language patents and periodicals, the details were not well known in other countries. By 1958 Dr. Hatvany had patented a system for operating a machine tool directly by a computer (DNC) instead of by magnetic or punched tape. Subsequently, and probably for the first time anywhere, the Hatvany team successfully combined computer-aided design data, NC programming, and DNC into a manufacturing system. The group also installed four major computerized design and manufacturing systems in Hungary.

From 1964 until his death, Dr. Hatvany was an active staff member of the Computer and Automation Institute of the Hungarian Academy of Sciences. He was a head of a Department and then of the Division of Mechanical Engineering until 1981 when he became a technical adviser to the director. They were probably the most satisfying and rewarding years of his career.

The Hungarian Academy of Sciences named Dr. Hatvany a Candidate of Sciences (Ph.D.) in 1968. The Hungarian Society of Mechanical Engineers gave him its Gold Medal for Development of Technology in 1977. The State Prize for Science and Technology, the highest Hungarian honor for engineers, was awarded to Dr. Hatvany by the Council of Ministers in 1978. He received the Gold Medals for

Outstanding Inventions from the Hungarian Academy of Sciences in 1978, 1980, 1981, and 1982. The Computer Automation Institute honored him with its Benedikt Prize in 1983, and the following year he was designated a Titular Professor by the Budapest Technical University.

An ardent worker on behalf of his country's technical societies, Dr. Hatvany was active in the Hungarian Society of Mechanical Engineers and served on its Automation Committee from 1976 to 1983. He was chairman of the Computer/Controls Group of the Hungarian Society for Measurement and Automation from 1978 to 1980.

Dr. Hatvany was a talented native of a small country that has produced an unusually large proportion of able engineers and scientists. Like many other Hungarians, he became a leader in the worldwide technical community. His quick mind and eclectic education and experience stimulated unusual insights for identifying and solving important problems. His talent for friendship and his fluency in five languages enhanced those skills. He made good use of those assets in fostering international cooperation through technical organizations and publications. Between 1971 and 1983 he worked hard on committees that sponsored seven international conferences on manufacturing, and he lectured at eleven such meetings. Dr. Hatvany was a productive member of the International Federation for Information Processing (IFIP) and chaired the Committee on Discrete Manufacturing from 1973 to 1979 and the committees on Computer Applications and Computer-Aided Design for even longer periods of time.

The contributions Dr. Hatvany made to manufacturing engineering and to international cooperation in technical matters were widely recognized. The Soviet Union presented him with its Gold Medal for Advancing the National Economy in 1973. The following year he spent as a research scholar at the International Institute of Applied Systems Analysis in Austria. In 1977 IFIP honored Dr. Hatvany with its Silver Core Award. He spent 1981 as a visiting professor at the

Ecole Nationale de Electronique et Informatique in Toulouse and in 1985 received an honorary doctorate from that university. In 1984 Dr. Hatvany was elected to membership in the International Institute for Production Engineering Research (CIRP). Members of that small but influential organization are chosen from educators and research workers in twenty-nine countries.

The National Academy of Engineering elected Dr. Hatvany a foreign associate, the first from Hungary, in 1985. He was probably best known to NAE members as the senior author of the National Research Council's worldwide survey on the status of computer-assisted manufacturing published in 1981. He also contributed to the 1984 publication *Computer Integration of Engineering Design and Production—A National Opportunity* issued by the National Academy Press.

Dr. Hatvany was a successful leader of research and development teams and a dedicated member of many technical committees. Such activities undoubtedly accelerated technical progress but it is difficult to trace specific contributions to particular individuals. The case for Dr. Hatvany will be easier to establish, however, because he had a talent for friendship. He is remembered with admiration and deep affection by his colleagues and acquaintances. More than twenty-five engineers from eleven countries are preparing articles for a *Jozsef Hatvany Memorial Issue* of *Computers in Industry.* The authors will describe his contributions and the current status of the fields he pioneered.

Robert A. Henle

1924-1989

By Erich Bloch

Robert A. Henle, a pioneer in semiconductor technology and the director of the Advanced Silicon Technology Laboratory in the IBM Thomas J. Watson Research Center, died January 27, 1989. Mr. Henle was an IBM fellow, an Institute of Electrical and Electronics Engineers (IEEE) fellow, a member of the National Academy of Engineering, and a recipient of the IEEE Edison Medal in 1987 for his "sustained efforts in, and individual contributions to, the science and technology of semiconductor circuits in computing systems."

Born in Virginia, Minnesota, in 1924, Mr. Henle served as a Navy pilot from 1944 to 1946 and then returned to the University of Minnesota, from which he received his B.S. and M.S. in electrical engineering in 1949 and 1951, respectively. He joined IBM soon after his graduation, and remained there throughout a career that spanned more than thirty-five years of remarkable productivity.

Bob Henle began working on transistor circuits while still a graduate student; his M.S. thesis investigated the operation of a point contact transistor in a bistable circuit. At IBM he joined a group studying the application of semiconductor devices to computers. This early work in solid state circuits was applied first in various accounting machines and then on a large scale in the IBM 608, which was IBM's first all-transistor computer. He then worked to develop high-speed circuits for the Stretch Computer System and the IBM 7090 series computers, which were at the leading edge of computer designs in the late 1950s, and for the Model 91 in 1962. This work was extraordinarily important to IBM and the future direction of the entire computer industry, for Bob Henle's work and personal determination were the key factors in IBM's decision in the 1960s to convert to solid state electronics for all computer systems. In recognition of these contributions, he was appointed an IBM fellow in 1964.

As an IBM fellow, Henle concentrated on developing monolithic memory technology, the first application of which was in storage protect memory in the System 360/Models 91 and 95. The basic techniques he invented became the foundation of all IBM semiconductor main memories and influenced the entire semiconductor industry. He developed the 128-bit chip that was used in 1970 in the main memory of the System 360/Model 145, and his memory technology was the basis of the IBM System 370 family of machines.

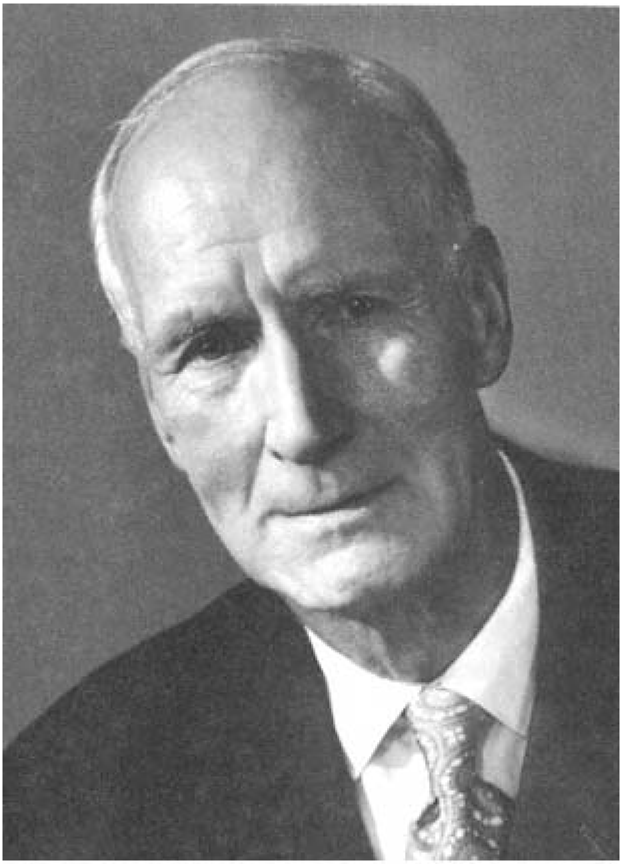
Henle became manager of Advanced Technology for IBM's Components Laboratory in 1975, and was appointed director of the Advanced Silicon Technology Laboratory in 1980. In that position he directed an interdivisional laboratory that has been responsible for many of the most important of IBM's current technologies. In addition Henle served two terms on IBM's Corporate Technology Committee, a body that oversees technology development for the entire corporation.

Throughout his career Bob Henle had a remarkable ability to combine scientific and engineering insights to create new concepts and new products. He was one of the first to see the limits of ferrite cores—the dominant memory technology of the 1950s and 1960s—and to understand the potential of monolithic memory technology to increase the capacity and speed of computer memories, thus making possible entire new generations of computers.

He never stopped searching and learning, or trying new ideas on old and unanswered problems, and this made him a respected teacher as well as a distinguished researcher. He remained a productive inventor to the end of his career, with forty-eight patents and more than twenty-five papers to his credit. His advice was sought after by the technical community inside and outside of IBM, and he continued to set an example for younger engineers.

Mr. Henle was honored for his accomplishments in many ways. He received the Department of Defense Citation for "Exceptionally Meritorious Civilian Service" in 1974. He was elected a fellow of the IEEE in 1966 and to the National Academy of Engineering in 1982. In April of 1988 a symposium in his honor was held at the IBM Thomas J. Watson Research Center. At various times in his career he chaired a number of committees of the IEEE, and he also served as an officer in the Computer Society.

Robert Henle devoted his life to creating some of the most important technologies of the modern world. His accomplishments have affected all of us indirectly, while those of us who were privileged to know him and to work with him were affected in a direct and inspiring way. He lived his life fully and productively, and in that he was an inspiration to us all.



Lord Christopher Hinton of Bankside

1901-1983

By Walker L. Cisler

Lord Hinton of Bankside, deputy chairman, Electricity Supply Research Council at the Electricity Council, died in London, England, on June 22, 1983, at the age of eighty-two. He was a highly respected, internationally known engineer and executive as a result of his activities in the World Energy Conference, of which he was honorary chairman of the International Executive Council, and his pioneering work in nuclear energy and power systems engineering.

In the August 1983 issue of the British magazine *Atom,* the following statement appeared:

> With the death of Lord Hinton at the age of 82, Britain has lost one of its great contemporary engineers, and his passing brings a measure of sadness to all those who were privileged to serve him in the early days of nuclear power in this country. A brilliant technologist and outstanding administrator, his strength stemmed largely from an unswerving faith in what he was doing, backed with a steely resolve and a broad mastering of the engineering disciplines.

He was born on May 12, 1901, at Tisbury, Wiltshire, England, and educated at Cambridge University, graduating from Trinity College in 1926 with 1st Class Honors. He was a member of seven of the principal engineering institutes in Britain and an honorary member of the American Society of Mechanical Engineers. He was an honorary fellow, Trinity College, Cambridge, 1957, and a fellow of the Royal Society, 1954. Hinton received honorary doctor's degrees from five universities in Britain, the Albert Medal and the Order of Merit among many other awards, and the Imperial Order of the Rising Sun (2nd Class), 1966. He was Knighted in 1951, became a Knight Commander of the British Empire in 1957, and a Life Peer in 1965. He was chancellor of the University of Bath from 1966 to 1980, special adviser to the World Bank, and from 1962 to 1968 chairman of the International Council and British National Committee, World Energy Conference. He was elected a foreign associate of the National Academy of Engineering in 1976.

Hinton had a combination of abilities that made him an unusually effective engineer. He was an excellent engineer with a full knowledge of fundamentals; he was a good organizer of large technical projects; he was far-seeing and most persuasive on matters of technical policy; and, perhaps most important of all, he firmly believed in the importance of whatever project he undertook, which gave him the courage and tenacity to see them successfully completed.

His employment began with Imperial Chemical Industries (ICI), and at the age of twenty-nine he was appointed chief engineer of the Alkali Groups. While at ICI, he was selected to start building atomic power plants. How well he succeeded is attested to by the completion of Britain's first four major atomic plants in six years, a tremendous achievement by today's standards. Beginning in 1946 at Risley with the miscellaneous staff of twelve, he laid the foundations for the Nuclear Power Center, which is among the largest and best of its kind in the world.

Any tribute to Lord Hinton must make reference to his founding role in fast breeder technology. The decision to build the Dounreay Fast Reactor (DFR) in 1954 showed his far-sighted assessment of the major role fast reactors would one day play. He personally visited Thurso, near the DFR site, on several occasions to explain to the local people the need for Dounreay, laying the foundation of overwhelming local support for the fast reactor plants. In 1977 he returned to Dounreay to shut down the DFR he helped to conceive nearly twenty-five years earlier. DFR had fully met the task for which it was built: to demonstrate that fast reactors could be constructed and safely operated. Until his death, Lord Hinton remained interested in the newer Prototype Fast Reactor and the future development of the fast breeder reactor system.

In 1957 he was appointed the first chairman of the Central Electricity Generating Board of Great Britain, a position he held until 1964. During that period, there was a vast expansion of the electric power grid in England. In this undertaking Lord Hinton exhibited most strongly his administrative as well as his technical abilities. His insistence that safety and reliability were of first importance in a power plant, whether fossil or nuclear, served the power industry of Great Britain very well indeed. Equally of note were his early concerns about the environment and pollution, which led to his development of the Board's research activities. In his retirement until his death, Lord Hinton was an active deputy chairman of the industry's research council.

Hinton's principal activity in the international energy field was through his long association with the World Power Conference, now renamed the World Energy Conference. Its purpose from the beginning was to bring together those concerned, at a high international level, with the development and use of all sources and forms of energy. This objective was, and is still, mainly achieved by holding a congress organized for a large and still growing number of countries.

In 1962 Hinton accepted the chairmanship of the British National Committee of the World Energy Conference, and in the same year he was elected to a six-year term as chairman of the Conference International Executive Committee. He was in a large measure responsible for the high esteem held throughtout the world for the World Energy Conference.

He was instrumental in changing the focus of the Conference from power only to the much wider scope of energy as a whole.

Hinton's precise grasp of energy problems confronting the developing countries and his ability to find practical and acceptable engineering solutions to such problems won him friends in many countries. His contributions to this worthwhile effort will be long remembered.

Because of his unrelenting pursuit of excellence, he was sometimes referred to as a technical autocrat. Yet, with a gentle side to his character, he was very much a man for his time and has left a void that will be difficult to fill not only in his own country, but elsewhere as well. Even at eighty-two, his remarks to students at the University of Bath, of which he was the first chancellor, are indicative of his optimism for the future and his oft-demonstrated courage in meeting head-on its problems: "You are going out into a changing world . . . but all change is a challenge. I am not offering you any pity. What I wish is that I was young enough to share the challenge with you."

Leroy Wallace Holm

1923-1989

By Henry J. Ramey, Jr.

Wally Holm, an oil recovery research pioneer and prolific inventor of enhanced oil recovery methods, died October 23, 1989, of cancer at age sixty-six. Wally Holm retired in 1986 after forty years with Union Oil Company of California (UNOCAL). He began work on enhanced oil recovery processes after becoming an authority on lubricating oils. His innovative approach to solving problems led to sixty-four patents and more than forty publications. His patents and publications cover a broad spectrum of oil recovery methods: carbon dioxide waterflooding, hydrocarbon-alcohol miscible displacement, nitrogen and steam flooding, steam and carbon dioxide processes, chemical flooding with surfactants and polymers, and use of foam for mobility control. His interests were always on the cutting edge of the technology. He used producing oil fields as his laboratory, and his efforts will aid human movement on planet Earth for years to come. His work led to greater prosperity for many parts of the United States and other nations in the world.

Wally Holm was born in Chicago, Illinois, on May 19, 1923. He received a B.S. in chemical engineering from Northwestern University in 1945. He served three years in the U.S. Navy reaching the rank of lieutenant. He married Vivian Lorenz of Chicago, Illinois, in 1945, and they had three children: Lawrence, Carol, and Jeffrey. Wally was encouraged by his loving family; six grandchildren; and brothers, Willard and Marvin.

In 1946 Wally joined the Pure Oil Company in Illinois, where he became a senior research engineer in petroleum refining. Because of original innovative talents, he became an expert on refining of lubricating oils and enhanced oil recovery. He received eighteen patents assigned to the Pure Oil Company. In 1965 the Pure Oil Company was purchased by the Union Oil Company. Wally continued his career with UNOCAL, serving as senior research engineer of petroleum production, research section supervisor, research engineering and senior research associate, and staff consultant, the highest scientific position at the Fred L. Hartley Research Center, Brea, California. Perhaps Wally's greatest gift was his unflagging, youthful enthusiasm for investigation. He was articulate and inspiring. For the Society of Petroleum Engineers (SPE) of the American Institute of Mining, Metallurgical and Petroleum Engineers, he was one of the SPE Distinguished Lecturers in 1972. He was an invited lecturer at many universities.

As a researcher, Wally was extremely creative and innovative. He was an experimentalist and always had several programs going simultaneously. His curiosity and tremendous energy drove him to investigate many different areas. He made significant contributions to miscible flooding, foam applications, and micellar/polymer flooding. He had a great ability to generate enthusiasm and a spirit of cooperation among his coworkers. This came from his friendly nature and his generosity in sharing ideas and credit for results throughout his career. This is demonstrated by the great number of collaborators Wally had at Pure Oil, Union Oil, and other companies. It was his generosity with both time and ideas that attracted so many good people. Many consider the time spent working with Wally as the most enjoyable times of their careers. He was honored and loved by his colleagues. He greeted everyone with a ready smile. He was described as one of the top three pioneers of enhanced oil recovery in the world.

The SPE honored Wally as a Distinguished Member (1984), a Distinguished Author (1981), an Enhanced Oil Recovery Pioneer (1984), and by the John Franklin Carll Award (1985). His citation for the Carll Award included "for distinguished achievement in contributions to petroleum engineering and the technology of fluid mechanics, oil recovery processes and Enhanced Oil Recovery (EOR)." His service to the SPE included all local section offices through chairman of the Chicago Section and many national chairmanships. Wally was also recognized nationally. At a joint SPE-Department of Energy symposium on EOR in 1984, Wally was designated EOR Pioneer. He was elected to the National Academy of Engineering in 1986.

In addition to his professional career, Wally had many interests outside of work. He was an avid sailor and tennis player and spent many weekends at his mountain cabin. He was an excellent athlete and played senior league softball into his sixties. Wally and Vivian were superb round dancers and they often sought out local dances when travelling on business. Wally was also closely involved with the Presbyterian Church. He served the First Presbyterian Church of Fullerton, California, faithfully for many years as deacon and elder and as member and chairman of key committees. Wally initiated a program through the church to promote international peace, and this program continues today with his vision. We will all miss him.


John A. Hornbeck

John A. Hornbeck

1918-1987

By Morgan Sparks

John A. Hornbeck, retired vice-president of AT&T Bell Laboratories, died of an aneurysm January 30, 1987, in Savannah, Georgia, at age sixty-eight. His father was a college physics professor, and John grew up in Northfield, Minnesota, where he was born November 4, 1918, and Kalamazoo, Michigan—college towns where his father taught. He graduated from Oberlin College in 1939. It was at Oberlin that he met Emily Elizabeth Aldrich. Their marriage and the family of five children—Joan, Deborah, Kirk, Jeff, and Christopher—were an inspiration to John's productive life.

He went to the Massachusetts Institute of Technology (MIT) and received a Ph.D. in physics in 1946. During World War II, he worked on National Defense Research Committee projects at MIT, and when the war ended, he joined Bell Labs as a research physicist. He was a member of a small group that started a program in gaseous electronics. He worked in this field and in semiconductor physics for about six years, resulting in publication of a number of papers. His best known achievement in this period was the discovery and study of the Hornbeck-Molnar effect, an ionization process by which molecular ions are formed in the noble gases helium, neon, and argon.

The transistor had been developed at Bell Labs in 1948, and a large associated program was mushrooming in the early fifties. John Hornbeck was asked to head a new department in solid state physics in 1953. This changed his orientation toward technical supervision and administration. Promotions and broader responsibilities followed. In 1958 he became executive director of Semiconductor Device and Electron Tube Division.

Two years later Bell Labs launched a major development project—Telstar, the first active communication satellite. John's organization had responsibility for designing and building all of the necessary semiconductor devices, solar cells, and travelling-wave tubes; providing the thermal design; and, with other organizations, handling part of the mechanical design and overall testing of the satellite. Many components had to be developed simultaneously with the systems design. John later recalled this as an audacious but very thrilling period.

This experience was good preparation for John's next job. In 1962 AT&T contracted with the National Aeronautics and Space Administration (NASA) to perform technical assistance for the Apollo program. Three months before the successful Telstar I launch, John went to Washington as president of Bellcomm, Inc., a subsidiary company created for Apollo support. His administrative skills were well matched to this assignment. He was an excellent organizer, a stimulating and effective recruiter of key personnel, and a leader who insisted on clearly stated and well-understood objectives. He established the basic relationships with NASA headquarters management, and determined what was and what was not the role of Bellcomm. The result was good definition of the tasks and subsequent delivery of key documents covering specifications for Apollo hardware and mission-by-mission objectives of the program.

In 1966 John was elected president of Sandia Laboratories, and the family moved again—this time to Albuquerque, New Mexico. Sandia is a large engineering and research laboratory operated for the government in Albuquerque and Livermore, California, by AT&T on a nonprofit basis. It is part of the nation's nuclear weapons complex and was under the Atomic Energy Commission during John's tenure. This was an entirely new kind of work for John. He responded characteristically, and focused on organizational structure and clarity of technical objectives. He set up an extensive in-house continuing education program and strengthened technical recruiting at the Ph.D. level.

John returned to Bell Labs in 1972 as vice-president of electronic technology. In 1975 he became vice-president of computer technology, design engineering, and information systems. He retired in 1979 and settled with his wife on St. Simons Island off the Georgia coast. They continued, as they had for many years, to spend summers at a family vacation cottage in Michigan.

John Hornbeck had a full, interesting, and varied career. In his own words, "As important as technological developments are, the greatest thing is the people you interact with along the way. I've really enjoyed working with people at Bell Labs and in the government—and sometimes being the contact between them." Speaking about John at the time of his retirement, Bell Labs Chairman William 0. Baker said, "John Hornbeck has been intimately involved in the epochal evolutions of solid state electronics, space exploration, nuclear technology, and digital computers. He has helped to organize talented work in each of those activities."

In addition to his membership in the National Academy of Engineering, John was a fellow of the American Physical Society and the Institute of Electrical and Electronics Engineers, and a member of the American Association for the Advancement of Science. He served on the Naval Studies Board of the National Research Council and NASA's Aerospace Safety Advisory Panel. He was chairman of the National Academy of Science's Evaluation Panel for the Institute for Basic Standards, technical adviser for the National Bureau of Standards, and chairman of the New Mexico Governor's Committee on Technical Excellence. He was also active in community affairs, having served as president of the Somerset Hills (New Jersey) Community Chest, president of the Albuquerque United Community Fund, and director of the Albuquerque Presbyterian Hospital Foundation.

Herbert H. Johnson

1931-1989

By John P. Hirth

Herbert H. Johnson, a national leader in the materials field, died October 1, 1989, after a lengthy illness. A longtime member of the faculty at Cornell University, Herb Johnson had been at the forefront of research in materials for thirty years and had been one of the prime movers in the United States in organizing and managing interdisciplinary materials research. In addition to a number of awards, his excellence was recognized by his election to the National Academy of Engineering (NAE) in 1987.

Herb Johnson was born in Cleveland, Ohio, in 1931 and received his early education there. He attended Case Institute of Technology (now Case Western Reserve University) for both his undergraduate and graduate education, achieving a B.Sc. in physics in 1952, an M.S. in physical metallurgy in 1954, and a Ph.D. in physical metallurgy in 1957. He married his wife, Marguerite (Marnie), a charming lady who supported him throughout his career, and together they raised a family of two sons and three daughters.

At Case he worked with A. R. Troiano, also a member of the NAE. Herb's thesis on hydrogen embrittlement in high-strength steels was a seminal achievement that provided the basis for our present understanding of hydrogen embrittlement of steels. His later research work included studies of fracture, fatigue, diffusion, phase transformations, and dislocation mechanics. However, the study of hydrogen effects in metals remained one of his major interests throughout his career.

Upon graduating from Case, he joined Lehigh University as an assistant professor of metallurgy for the period 1957-1960. Herb then moved to Cornell University, where he remained throughout his career except for a period as visiting professor at the Massachusetts Institute of Technology (1967-1968). While at Cornell he served as chairman of the Department of Materials Science and Engineering (1970-1974) and as director of the Materials Research Laboratory (MRL) (1974-1984).

His research work was characterized as being thoughtfully conceived, innovative, carefully performed, and significant. He was consistently productive, including his periods of administrative responsibility, and produced a truly classic paper every five or ten years. One of his papers on fracture mechanics has been designated a citation classic. In recognition of his research accomplishments, he was named a Case scholar, a fellow of the American Society for Metals, and a councillor of the Materials Research Society. Also, he delivered the Campbell Lecture of the American Society for Metals. He was invited to present numerous keynote/plenary lectures as well.

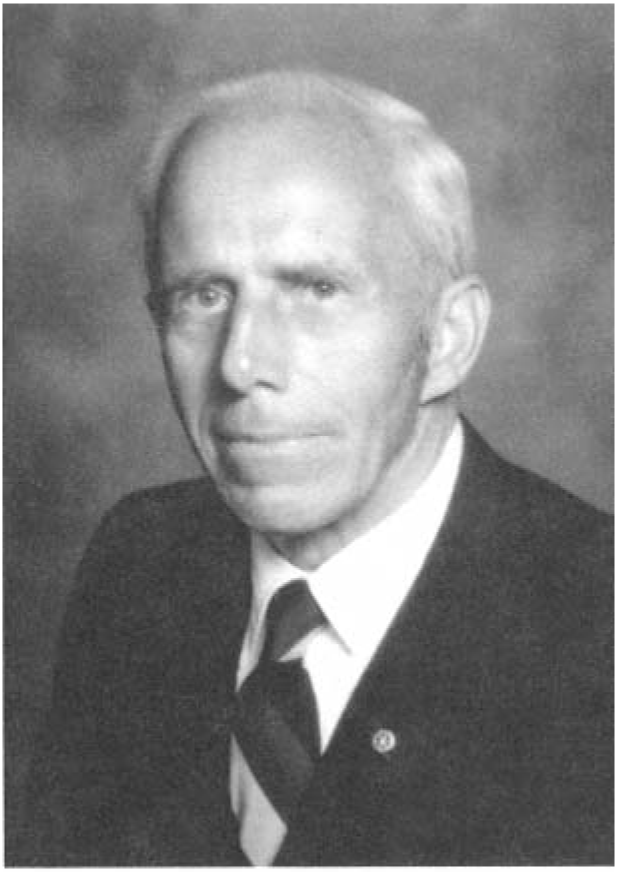
In his work he had a keen sense of seeking the fundamental mechanisms for processes. As a consequence, his work has withstood the test of time and remains valid today. Particularly noteworthy was his work on the decohesion mechanics of hydrogen embrittlement, mentioned earlier, where hydrogen accumulates in the stressed region ahead of crack tips and there promotes crack propagation; on hydrogen permeation and trapping in metals; and more generally on environmental degradation. In his last few years, he innovatively used techniques from the semiconducting processing industry to make nanoscale particles to test size effects on mechanical properties, a contribution to the new field of ultrafine microstructures.

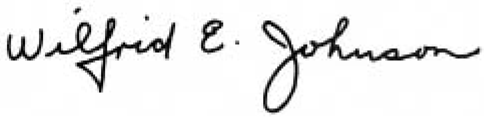
In some of this work he collaborated with others in a most helpful and thoughtful manner.

In addition to his research achievements, Herb Johnson made unique contributions to research management that effectively set the standard for university-based interdisciplinary laboratories. Under his leadership the size and funding of the Cornell MRL grew, making it the largest such laboratory in the National Science Foundation program. One of his major achievements was in the development of state-of-the-art central facilities with a heavy emphasis on networked applications of computers. Another major contribution was in the judicious use of seed funding for new programs and facilities. The many successes included the High Energy Synchrotron Source; the Rutherford back-scattering facility; the MicroKelvin low-temperature facility; and programs in polymer crazing, nonlinear optical materials, and high-pressure effects. He insisted that a significant portion of the program be in support of graduate education, with about one hundred students receiving their Ph.D. degrees during his tenure.

He was extremely effective in governmental and societal committees and boards and was widely sought as a participant. He served with distinction on NAE/National Academy of Sciences panels, was chairman of the solid state sciences committee of the National Research Council, and chaired a number of committees for both the Metallurgical Society and the American Society for Metals. Herb was instrumental in defining and initiating the Center for Materials Science at Los Alamos National Laboratory, and he provided continued advice and collaboration for many years as a member of the External Advisory Committee of the Center. He was incisive in cutting through a discussion with a logical solution and would enliven a debate with his dry humor. On several occasions he was complimented by chairs and others on his ability to resolve complex issues. He could be somewhat stubborn in adhering to his views, but was not adamant when sound alternatives were presented.

For many of us in the materials field, Herb Johnson was a warm friend, a reliable critic, a valuable collaborator, and a respected colleague. He will be greatly missed, though his influence through his lasting contributions will be with us for many years.




Wilfrid E. Johnson

Wilfrid E. Johnson

1905-1985

By Roy H. Beaton

Wilfrid E. Johnson, an early pioneer in the nation's jet engine program and a key figure in the success of national nuclear programs (both weapons and electric power), died on February 10, 1985, at age seventy-nine. At the time of his death, he had been retired for over ten years while residing in Richland, Washington, with his wife of over fifty-four years, Esther Taylor Johnson. Although originally a skilled machinist-mechanic, he rose to become an "engineer's engineer," a highly effective industrial manager, and a top federal administrator in a "series" of careers.

Wilfrid Johnson was born in a small coastal town, Whitley Bay, England, on May 24, 1905. As was the custom in that part of the world at that time, he left school to go to work after completing the first eight grades at the age of twelve. With his mother and step-father, he emigrated to the United States when he was fifteen years old, arriving in Astoria, Oregon, in September 1920.

Wilfrid served as a machinist's apprentice at Pacific Machine & Blacksmith Shop in Astoria on the Columbia River for six years. Enroute to receiving his Journeyman's certificate at age twenty-one, he became recognized as a most capable and dedicated mechanic in the repair and maintenance of all types of marine engines in the hundreds of small and large fishing boats making Astoria their home port.

In 1926 when he was twenty-one, he became a naturalized citizen of the United States. Simultaneously, he learned that under federal law "Land Grant" colleges like Oregon State College were required to admit student applicants over twenty-one without high school diplomas, providing they continued work on obtaining a diploma. Accordingly, Wilfrid enrolled in mechanical engineering at Oregon State College at Corvallis in 1926 while studying high school courses on his own. By "burning the candle at both ends," Wilfrid received his diploma in 1928 and in 1930 his B.S. in mechanical engineering from Oregon State College. At his graduation he received the Joseph H. Albert Award as the "Outstanding Senior in Engineering School."

Prior to graduation Wilfrid had been signed up by General Electric Company (GE) recruiters at the Corvallis campus. He then journeyed to Schenectady, New York, to report for work, where he was assigned as a design and development engineer in refrigeration engineering, a position he was to fill with steadily increasing responsibility for the next ten years. Meanwhile, Wilfrid continued to press his suit with his college sweetheart, Esther Taylor, back at Oregon State College. They were married in 1930.

In GE refrigeration engineering, Wilfrid became both a prolific inventor and technical paper writer during the 1930s, turning out papers on everything mechanical from diesel engine crankshafts to cone pulleys, flexural springs, and compressors, and obtaining and assigning to GE about a dozen patents on refrigeration devices. During this period, among other achievements, he successfully designed and developed the first hermetically sealed compressors for use in household refrigerators. Later, he also designed and developed the first "service-sealed" compressor for use in commercial water coolers. In 1939 Wilfrid was granted an M.S. in mechanical engineering by Oregon State College, based almost entirely on the number and quality of his technical papers published after he had received his B.S. degree.

Early in World War II, Wilfrid was transferred into classified aircraft engine turbo-supercharger development and production operations of GE at Lynn, Massachusetts, and Syracuse, New York. He successfully brought previously developed superchargers into high-volume production by applying ingenious manufacturing engineering techniques. He coordinated the design work at five different plants and closely supervised the design development of the CH-5 supercharger. This new supercharger, when combined with an improved version of a Pratt & Whitney engine, rejuvenated production of the P-57 (Thunderbolt) aircraft, ultimately one of the most successful planes in the Allied arsenal.

Still later in World War II (1944-45), while serving as division engineer in GE's Aircraft Gas Turbine Engineering Division, Syracuse, New York, Wilfrid recruited, organized, and trained an engineering force to carry out the development and production testing of early jet engines for aircraft. This organization accepted an incompletely developed jet engine design from Frank Whipple of British Rolls Royce, completed its development, and successfully placed it in production. Wilfrid subsequently became general manager of this first U.S. jet engine production plant. No engine produced by this GE Syracuse plant ever failed in flight.

During the period 1945-48, Wilfrid served as manager of GE's Engineering, Air Conditioning Department. In this position he rebuilt the entire postwar organization and successfully converted the department back to peacetime production. In 1948 because of his effectiveness in these activities, he was transferred to the Hanford Atomic Products Operation at Richland, Washington, owned by the U.S. Atomic Energy Commission (AEC) and operated under contract by GE. For several years he served as manager of design and construction. In 1951 he was made assistant general manager, and in 1952 he became general manager, where he served until 1966.

During this period, Wilfrid was responsible for carrying out a massive postwar program of design, construction, startup, and subsequent successful operation of many new plutonium production and product separation facilities at Hanford. These included at least five new production reactors (two of them twice as large as any built before), a new Redox and later a Purex solvent extraction separations plant, a Remotely-Operated Final Metal-Purification Plant (234-5), and eventually the AEC's first dual-purpose (plutonium and power production) New Production Reactor (NPR). This reactor was shut down for updating and modernization after more than twenty-three years of successfully producing weapons-grade plutonium and waste heat steam for the generation of eight hundred megawatts of electric power. For his successful direction of all these activities, the AEC awarded Wilfrid in 1966 its Special Citation for Leadership.

On May 1, 1966, Wilfrid elected to take an optional early retirement from GE, but continued to serve as a consultant to the company's new Nuclear Power Operations headquartered at San Jose, California. Shortly thereafter President Johnson appointed him a commissioner of the AEC. Approved by the U.S. Senate, Wilfrid took office on August 1, 1966, filling the unexpired term of Commissioner John G. Palfrey. On June 8, 1967, President Johnson reappointed him for a new five-year term of his own, extending through June 30, 1972. During this period, Wilfrid participated actively in the AEC's extensive expansion of its licensing of commercial nuclear power plants.

Wilfrid Johnson was professionally active throughout his long career. In 1938 he received the "Outstanding Young Engineer Within Ten Years" award from Pi Tau Sigma. In 1959 he was granted an honorary D. Eng. degree from Oregon State College and also elected to Sigma Xi. In 1968 he was elected to the National Academy of Engineering for his "contributions to jet engine manufacturing engineering and nuclear materials production." He was a fellow of both the American Society of Mechanical Engineers and the American Nuclear Society, as well as a member of the honorary societies of Tau Beta Pi, Phi Kappa Phi, Sigma Tau, and Pi Tau Sigma.

Wilfrid and Esther Johnson raised three children: Louise McKee of Bellevue, Washington, and Robert and Richard, both of New York City. Wilfrid had a lifelong love affair with horses as an avocation, beginning as a young boy. He learned to ride with professional skill while a member of the R.O.T.C. at Oregon State College, where he became a member of Scabbard & Blade before receiving his commission as 2nd Lieutenant in Field Artillery. He did not get his own horse until he had been married for ten years, but was rarely without horses from that time on.

Wilfrid remained personally grateful to this country throughout his lifetime for what he perceived it had offered to him in opportunities and rewards for a young immigrant boy with little initial formal schooling. On the other hand, he more than paid for his advancement and rewards by dedicated hard work and striving for perfection on everything he touched or worked on. Those who worked around him, either above or below, were compelled to perform similarly!

Overall, Wilfrid Johnson was most impressive as an associate, awesome as a boss, and miles ahead of his time in the application of the principles of professional business management. He was the kind of man who will always be missed very much!

Bruce G. Johnston

1905-1989

By Lynn S. Beedle

Bruce G. Johnston, a world-renowned authority on the behavior and design of steel structural members and frames, died on October 11, 1989, in Tucson, Arizona, two days before his eighty-fourth birthday. He directed early research work on torsion of beams, behavior of semirigid connections, plastic design of steel frames, and the inelastic strength of beams and columns. In the field of plastic design, he pointed research toward the development of specification requirements that were instrumental in its acceptance as a design tool. Dr. Johnston developed the postwar research program in structures at the Fritz Engineering Laboratory, Lehigh University. He was a leading figure in the organization of the Structural Stability Research Council.

Dr. Johnston was born in Detroit, Michigan, on October 13, 1905. He married Ruth Barker in August 1939, and they had three children: Sterling, Carol, and David. His father was a structural engineer and a specialist in the planning of construction and erection of large bridges. Dr. Johnston spent his early youth in such widely separated places as Ontario, Florida, North Carolina, and Kansas. His four years of high school were spent successively in Colorado, Utah, Missouri, and Kansas.

In 1925 he completed his first year at Kansas City Junior College, and he wrote of that experience:

> My one year in the class of '25 of KCKJC and the prior year in KCKHS were the most influential and inspirational school years of my life. Under the influence of such teachers as Christine Wenrich I found for the first time a real challenge in studies. The fundamentals of English usage and the basics in mathematics were invaluable preparation for later work.
>
> In the spring of 1925, after much mental floundering, my goals narrowed to civil engineering. This was the field in which my father, self-taught, had found such a satisfying career. In the summer of 1925, I went to the University of Illinois.

In 1927 he worked as a testing inspector on the Coolidge Dam in Arizona. In 1928 he returned to the University of Illinois, from which he graduated in 1930 with a B.S. in civil engineering. Upon his graduation from Illinois, he received the Ira 0. Baker First Place Award in Civil Engineering.

His two earlier years of work on the Coolidge Dam in Arizona had turned his interests toward concrete, and in 1930 with graduation pending from the University of Illinois, he sought and found an opening in the field of concrete design with the Roberts and Schaefer Engineering Company of Chicago. He described the transition of his interest from concrete to steel in the following way:

> Shortly before graduation from Illinois, in talking with one of my professors, the noted Hardy Cross, about this prospect, he said "Go ahead and take the job, but you will end up in steel because you have a mind that thinks in terms of steel." This forecast has always amazed me as I had spoken but little to Professor Cross during the previous term.
>
> In 1932 came the opportunity to return to school (at Lehigh University) to work on a research fellowship project on a topic suggested by the Bethlehem Steel Corporation—"structural beams in torsion." This work, involving both the application of Prandlt's soap film analogy and tests of actual members in torsion, resulted in the development of formulas that eventually permitted the accurate calculation and tabulation of St. Venant's torsion constant for rolled WF and I sections in the AISC (American Institute of Steel Construction) Manual. Some 30 years later the advent of the electronic computer permitted the improvement of these formulas by the difference-equation procedure and their extension to channel and angle shapes.

He received his M.S. at Lehigh in 1934 and became an instructor at Columbia University. He sought the advice of his father, Sterling Johnston, as to needs in steel structures research. Sterling had helped to plan the Quebec Bridge construction many years before and had noted a problem involving the dishing of thin pin-connected links. This led to work on that topic, which later resulted in changes to the AISC specifications.

Columbia awarded Bruce Johnston the Ph.D. in 1938. He describes his extra curricular experiences at this time of his life as follows:

> In 1937, to Africa on a decrepit freighter for a summer in French Cameroun. Thirty-eight days enroute, with shore stops at Dakar, Conakry, Monrovia, Abidjan, Accra, and Lagos. Learned how to splice rope and make a sling from a sailor. Inland to Bafia, in high grass country, to build and erect roof trusses for a church with a crew of 125 Bulu people—one generation removed from cannibalism.
>
> Back to Columbia via German banana boat. As we neared Hamburg the captain and crew went increasingly into their "Heil Hitler" form of greeting. On the last night the captain gave a speech on German-American friendship. It was 1937. Everywhere in Germany the people were exhorted by posters to fear the dangers of world communism. It was a prelude to devastation.
>
> Met Ruth, an art teacher at Skidmore College in Saratoga Springs, New York. 1938—received Ph.D. at Columbia and was offered an Assistant Professorship and Assistant Directorship of Fritz Engineering Laboratory at Lehigh University. Moved to Bethlehem, Pennsylvania.

As assistant director, then associate director, and finally as director, Dr. Johnston was in charge of structural research programs at Lehigh's Fritz Engineering Laboratory from 1938 until 1950, except for a two-year interruption during World War II while he was first a design engineer for the U.S. Navy Bureau of Yards and Docks and then engaged in the study of vibration and shock-load problems related to the development of the proximity fuse and naval gun directors at the Johns Hopkins Laboratory of Applied Physics.

In 1950 he accepted the call of the University of Michigan and became professor of structural engineering. For the ensuing eighteen years, he devoted his attention to research, teaching, and professional activities.

In 1968 he retired and was named professor emeritus of the University of Michigan. The following is from the memoir adopted by the Regents:

> In professional circles, Professor Johnston enjoyed the unique distinction of presiding, at different times, over both the Structural and the Engineering Mechanics divisions of the American Society of Civil Engineers and of twice winning the Society's James J. R. Croes Medal. In addition to monographs, he wrote some sixty professional papers, many of them an extraordinary seminal value. He visited and lectured widely, furthermore lending his authoritative counsel to innumerable engineering groups—public and private, industrial, military, and academic.

Professor Glen Berg, one of his Ph.D. students at Michigan wrote, "He was one of the great persons in his field. With characteristic generosity he shared his wisdom and sound judgment freely with his colleagues".

Dr. Johnston then accepted a call from the University of Arizona to lecture in civil engineering.

Early research at Lehigh in the 1940s stimulated his interest in attaining a better understanding of metal column behavior, a topic that thereafter became a primary thread of interest.

> One of my earliest projects at Lehigh concerned the behavior of eccentrically loaded steel columns, a study sponsored by the American Institute of Steel Construction. In developing this work I discovered, to my chagrin, that in spite of three university degrees, including the Ph.D., I really understood next to nothing about the behavior of metal columns. Much of the next 40 years involved attempts to remedy this deficiency through diversified research projects at both Lehigh and the University of Michigan as well as through active participation in the work of the Column Research Council. These studies were, in part, an expression of my deeply held feeling that a University must not only fulfill its educational role of disseminating

knowledge, but must maintain a position on the creative forefront of knowledge in the fields of industry in which its young graduates go out to serve.

It was with this policy in mind that Dr. Johnston developed a strong graduate studies program in structural research at Lehigh. He initiated research at Lehigh on the effect of residual stress on column strength and conceived the importance of the strain-hardening modulus of structural steel in relation to the behavior of steel columns. He also developed Lehigh's initial research program on plastic design, directing it towards a delineation of design rules essential to successful application in practice.

In 1944 Dr. Johnston assisted in the organization of the Column Research Council (now known as the Structural Stability Research Council). He served as its chairman from 1956 to 1962. He has been editor and part author of the successive editions of the council's *Guide to Design Criteria for Metal Compression Members,* more conveniently known as the *CRC Guide.* In 1960 the first edition provided backup for important changes in the AISC specifications. Through his service on the Executive Committee, the council continued to have his guidance. He received American Society of Civil Engineers' (ASCE) Ernest E. Howard Award in 1974.

In the 1950s Dr. Johnston participated as a project supervisor in studies of the effects of atomic blast during tests at Yucca Flats, Nevada. He was in charge of the evaluation of test results for one group of industrial and commercial buildings under a contract with the Federal Civil Defense Administration.

During the 1960s and early 1970s, he was active as a consultant to the Association of Iron and Steel Engineers, assisting in the development of structural specifications for steel mill ladles, overhead traveling cranes, and mill building structures. He was a member of the Specification Advisory Committee of the AISC. From 1961 to 1963, he was a member of the Civil Defense Panel of the President's Science Advisory Committee.

He was one of the 1969 charter steering group members of the Joint Committee on Tall Buildings (now the Council on Tall Buildings and Urban Habitat). He served as cochairman of its editorial committee.

He was coauthor of the *Steel Design Manual* published by the U.S. Steel Corporation in 1968, and coauthored a beginning text *Basic Steel Design* first published in 1974. In 1969 he received the ASCE's highest award, that of honorary member. In 1979 he was elected to the National Academy of Engineering. In 1981 he received the "Alumni Honor Award for Distinguished Service in Engineering" from the University of Illinois.

Dr. Johnston was author or coauthor of more than seventy papers on structural research. He has always tried to consider both the values and limitations of theory and research on the one hand, the problems of the practicing engineer on the other, and how to bridge the gap between the two.

His retirement was a rich and rewarding time with his family in a relationship that all admired. As his daughter, Carol Snow, described in the memorial service to her father,

> Dad's life work was as engineer and educator. In the academic world, he was (as they say) "well published." But I want to share a different instance of being published that also pleased him. In June 1981 in *Golf Digest,* his short poem "The Numbers Game" was published. It goes:
>
> When Ruth requests some household chore,
> My age bears down at seventy-four.
> But when I stand out on the tee,
> I suddenly find I'm forty-three.


Donald L Katz

Donald LaVerne Katz

1907-1989

Submitted by the Nae Home Secretary
Prepared with the assistance of
the Nae Membership Office

Dr. Donald L. Katz, the A. H. White Distinguished University Professor Emeritus of Chemical Engineering, The University of Michigan, died on May 29, 1989. In areas of reservoir engineering such as phase behavior, vapor-liquid equilibrium, retrograde condensation in gas condensate systems, solid gas hydrate formations from water-gas during flow, and arctic gas hydrate formation, Dr. Katz was beyond question the world leader.

He was born near Jackson, Michigan, on August 1, 1907, and attended the University of Michigan, where he received the B.S. (1931), M.S. (1932), and Ph.D. (1933) in chemical engineering. During his academic program, he was elected to five honorary fraternities, including Tau Beta Pi and Phi Kappa Phi, and held the Gemel and Donovan undergraduate scholarships, in succession.

His first professional affiliation was with the Phillips Petroleum Company in Bartlesville, Oklahoma. The three years spent with Phillips in initiating a production research program set the pattern for his principal lifelong research interests: phase behavior of hydrocarbon systems and reservoir engineering. His publications, numbering 294, are concentrated in the petroleum field, but have included additional topics such as heat transfer, fluid dynamics, and the use of computers in engineering education. He is the author, together with former students, of nine books—the most significant, *Handbook of Natural Gas Engineering* (1959), was written with six former students. His most recently published book, *Natural Gas Engineering, Production and Storage,* with Robert L. Lee, was published by McGraw Hill in January 1990.

He returned to the Chemical Engineering Department of the University of Michigan in 1936, rose rapidly through the faculty ranks to professor, and was chairman of the department from 1951 to 1962. Forty-five doctoral students completed their theses under his supervision. Beginning in 1959 he directed two major national studies on the use of computers in engineering and engineering design education, with support from the Ford Foundation and the National Science Foundation. These projects involved participation of some two hundred engineering faculty members from more than fifty engineering schools. The reports, recommendations, and literature produced have had a national and international impact on engineering education.

Professor Katz travelled widely, contributing to improvement of graduate chemical engineering programs with seminars and workshops, particularly in the Far East, India, and Brazil (he spent a semester at the University of Brazil assisting in the inauguration of a new graduate program in 1963). He was awarded the University of Michigan's Distinguished Faculty Achievement Award in 1964 and was named the Alfred H. White Distinguished University Professor of Chemical Engineering in 1966. After his retirement in 1977, he remained very active as a consultant, lecturer, author, and member or leader of public service committees.

Throughout his career, Dr. Katz was a contributing member of many professional and technical societies. Dates of first membership and recognitions for his service and technical contributions are American Chemical Society (1932), E. V. Murphree Award in Industrial and Engineering Chemistry (1975); American Gas Association (1940), Gas Industry Research

Award (1977); American Institute of Chemical Engineers (1937), fellow, served on ten committees, president (1959), Founders Award (1964), Warren K. Lewis Award (1967), William H. Walker Award (1968), named one of twenty-nine eminent chemical engineers (1983); Society of Petroleum Engineers Inc. (SPE) of the American Institute of Mining, Metallurgical and Petroleum Engineers (AIME) (1936), served on six committees, SPE awards: one of the SPE Distinguished Lecturers (1962), John Franklin Carll Award (1964), one of first group of one hundred SPE Distinguished Members (1984); AIME awards: Mineral Industry Education Award (1970), Anthony F. Lucas Gold Medal (1979); American Association for Advancement of Science (1941), fellow; American Society for Engineering Education (1944), life member; American Association of Petroleum Geologists (1976-1988), associate member; American Society of Mechanical Engineers (1945), life member; American Nuclear Society (1956), fellow; National Society of Professional Engineers (1953), life member; and National Academy of Engineering (NAE) (1968). He also received the Hanlon Award (1950) from the Gas Processors Association, and the very special award—the National Medal of Science—in 1983, presented to him by President Reagan.

Dr. Katz was among a handful of scientific pioneers who created a new engineering discipline, petroleum reservoir engineering. Besides his research publications, he did intermittent consulting in oil production; but mainly he devoted his innovations to gas production and storage technology.

He assisted the management of three large midwestern companies to develop large underground gas storage systems during the period of 1950 to 1975. The ability to predict the storage capacity and delivery rates from reservoirs has contributed significantly to the efficient management of the nation's gas delivery system. By use of pressures above discovery pressures—a practice studied and recommended by Dr. Katz—the cost of gas storage has been significantly reduced, producing cost savings for both management and user. Dr. Katz was very active as a consulting engineer during the past forty years, having served more than one hundred companies and governmental agencies.

In the field of public service, he served on fourteen committees, mostly through the National Academy of Sciences (NAS), the National Academy of Engineering, and the National Research Council (NRC). He was chairman of the NRC Committee on Hazardous Materials, Advisory to the U.S. Coast Guard, from 1964 to 1972. He organized the group that prepared many reports covering such topics as a classification system for the hazards involved in shipping a group of 160 chemicals; pressure relief valves for pressure vessels on barges with fires aboard; and liquefied natural gas (LNG) safety and the nature of the LNG water-superheat-limit-flameless-explosion. At the conclusion of his eight years of service on this committee, Dr. Katz was presented with the Distinguished Public Service Award by the U.S. Coast Guard. He was also chairman in 1974-1975 of the NRC Review Committee on Air Quality and Power Plant Emissions. This committee was organized at the request of Senator Muskie's subcommittee, under Senator Randolph's Public Works Committee. A thorough study on acid rain and health was documented. The committee's report recommended stack gas scrubbing for new high-sulphur coal plants and some retrofits. Testimony was given by Dr. Katz to the subcommittee, with Senator Randolph presiding.

As a part of his service to the engineering profession, he gave many special lectures at universities in the United States and in foreign countries, invited lectures for professional societies and companies, and continued to give his annual one-week course on gas storage until 1987. In recognition of his many research contributions, the College of Engineering of the University of Michigan established the Donald L. Katz Lectureship in Chemical Engineering in 1971. This lectureship is awarded annually to distinguished faculty researchers from other universities; the 20th Katz lectures were given in Ann Arbor in April 1990. In addition, the

Gas Processors Association honored Professor Katz by creating the new Donald L. Katz award in 1985.

In his home community of Ann Arbor, Michigan, he served from 1948 to 1957 on the Board of Education, including three years as president; several new public school buildings were built during his presidency. In 1944-1945 he was president of the Ann Arbor Council of Churches, and served in many positions including chairman of the Official Board and lay leader of the First United Methodist Church.

Professor Katz had a lifelong interest in history. After his retirement, he wrote a monograph on the early history of farm and community life in the Waterloo township in Jackson County, Michigan, for which he received a citation from the Michigan Historical Society. He also wrote several family histories that required significant study of European village archives. He is survived by his wife Elizabeth, five children, ten grandchildren, and two great grandchildren.

Hugh S. Knowles

1904-1988

By Eugene F. Murphy

Hugh Shaler Knowles, physicist and consulting engineer famous for miniaturization of high-quality microphones and receivers, died in his sleep April 21, 1988, at the age of eighty-three. His work at Jensen Manufacturing Company contributed to early development of high-fidelity loudspeakers for indoor and outdoor use. He formed and headed until his death his own firms, notably Industrial Research Products, Inc. from 1946, and Knowles Electronics, Inc. from 1954, emphasizing successive reductions in size of high-quality transducers. He was active in national and international standardization, an officer and award recipient of professional societies, a wise adviser to government, and a generous supporter of basic and clinical research in hearing problems. He was widely admired for integrity and astute judgment.

Hugh Knowles was born in Hynes, Iowa, September 23, 1904, and spent much of his early years in Mexico, where his father was a mining engineer. His fluency in Spanish, French, and German was very useful in his business and standardization activities. After graduating at the age of fourteen from high school in San Antonio, Texas, he attended Alabama Polytechnic Institute in 1920 and 1921 and served as a radio operator on various ships from 1921 to 1924. By working as a department editor for *Popular Radio,* associate radio editor for the *New York Herald Tribune,* and receiving a scholarship in radio engineering, he attended Columbia University, receiving an B.A. (professional option) in 1928. He married Josephine Knotts that year. He was a graduate student in physics at the University of Chicago from 1930 to 1934 and a lecturer in graduate physics there from 1935 to 1936. He received an honorary doctor of science degree from Northwestern University in 1982.

With a growing family in the depression years, Hugh began work as an engineer at Jensen in 1931, becoming chief engineer and vice-president, and remaining to 1950. He was credited with the first permanent-magnet moving-coil loudspeakers, two-and three-way speaker systems, and the "bass reflex" vented loudspeaker enclosure improving low-frequency response.

He started, part time, his own consulting engineering practice in 1936, considered himself a consulting engineer, and was a registered engineer in Illinois from the initiation of that program in 1947. Forming Industrial Research Products in 1946 for research and development on a variety of products, he served as its president and director of research. After serving for years as president of Knowles Electronics, specializing in manufacturing hearing aid transducers, he became chairman of its board as well, and then relinquished his presidential responsibilities shortly before his death. Similarly he was president or chairman of subsidiaries in England and Taiwan and of other interests in Illinois.

Knowles was elected to the National Academy of Engineering (NAE) in 1969. He had already served in 1950-1951 as a member of the Physical Science Division of the National Research Council.

Most of his advisory services, though, were directly to the government. During and shortly after World War II he worked on blast-resistant loudspeakers for Navy ships, bullhorns for aircraft carriers, and fuzes for artillery and antiaircraft shells. From 1948 to 1950 he chaired the acoustics panel of the U.S. Department of Defense Research and Development Board.

His miniaturized microphones and receivers were used for lightweight headsets for astronauts, among many other applications. Knowles was proud that the National Aeronautics and Space Administration accepted his routinely stringent quality assurance. However, the Bolt Commission investigating the gap in President Nixon's tapes recorded in the Oval Office found a small hole in the President's desk leading to a plastic tube and a Knowles microphone so badly misapplied that it contributed to the poor a quality of the tapes!

His broad interest in fundamental as well as applied aspects of acoustics led Knowles to emphasize the need for better measurements of loudspeakers, of parameters of the human head at a range of frequencies in relation to bone conductor hearing aids, and of the acoustic impedance of the ear canal plugged by the receiver. He repeatedly urged more realistic methods of measuring hearing aid performance than the usual free-field tests of microphones and the conventional two-cubic centimeter coupler for the receivers.

To simulate use on an average person, he led development of KEMAR, or Knowles Electronics Manikin for Acoustic Research, a full-size head and upper torso with choice of one or two Zwislocki couplers mounted at the eardrum position(s). Nearly three hundred copies are used in many laboratories here and abroad in hearing aid and other studies.

Knowles was particularly pleased that he had contributed to the development of high-quality head-mounted hearing aids, marked improvements over the multipiece body-worn aids still routinely used after World War II. These earlier aids benefited from the printed circuits developed for proximity fuzes, and by 1953 from early transistors, which replaced the large "peanut" vacuum tubes that required more energy and both A and B batteries (usually in a separate pack). However, the users still carried them in a shirt pocket or special undergarment with a cord to the earphone.

Knowles mounted his small microphone and receiver, with impedances compatible with transistors and a transistorized printed circuit, in a thickened eyeglass temple with a short plastic tube leading to an earmold. This arrangement immediately removed dangling cords, cord breakage, and noise from clothing brushing over a microphone. Many patients wore two aids, over-coming the shadowing of sounds from the opposite side of the head, and localizing sound sources more rapidly. Aids were then mounted behind the ear, in the ear, and finally completely inside the ear canal—thus achieving an old goal.

Knowles did not attempt to manufacture or market hearing aids. Because his transducers were used by nearly all American manufacturers and some abroad, he was in constant touch with the entire industry and aware of its trends. Although he did not publicize this role, he was a very valuable member of the Veterans Administration's advisory committee on hearing aids performance. With his scrupulous integrity, he never betrayed commercial secrets. He provided selfless, impartial, and invaluable insights; broad knowledge of acoustics and of hearing aid measurements; and precise wording of controversial issues.

While at Jensen, Knowles was a member and eventually president of the Radio Engineers Club of Chicago, practically an honorary society of chief engineers. He was a fellow, president, honorary member, and Gold Medal recipient of the Audio Engineering Society; a fellow, president, and Silver Medal recipient in engineering acoustics of the Acoustical Society of America; a fellow and national chairman of the Institute of Radio Engineers (IRE) audio group (predecessor of the present Acoustics, Speech, and Signal Processing Society of the Institute of Electrical and Electronics Engineers); and a member of the IRE board of editors for fifteen years. He was the first American to receive the Alexander Graham Bell Award of the Hearing Aid Society of Germany. Though considering himself an engineer, he was a member of the governing board of the American Institute of Physics and of its executive committee.

Hugh Knowles had a long and distinguished service in standards, starting as chairman of an Acoustical Society of America Electroacoustics Committee from 1938 to 1941.

He was a member of the American Standards Association (now ANSI) Acoustical Standards Board. Long a member, for years he headed, the United States delegation to the International Electrotechnical Commission TC29, emphasizing engineering matters. Also, he chaired the International Standards Organization Committee TC43, concerned with psychoacoustical matters.

Knowles was the author of major chapters on loudspeakers, telephone receivers, and microphones for three engineering handbooks and of many technical articles. He held more than fifty patents.

Hugh and Josephine had three children, James, Margaret (Mrs. Schink), and Katherine (Mrs. Strasburg). Josephine died in 1969. Hugh later married a cousin, Nancy K. Knowles, with whose family he had maintained close contact since childhood.

Hugh was among the first donors to the NAE. He was always a very generous donor, particularly to the Acoustical Society of America, international standards activities, and academic acoustics programs. The Knowles family and companies, continuing and expanding Hugh's long generosity to Northwestern University in support of the audiology program headed by Raymond Carhart, established the Hugh Knowles Center for Clinical and Basic Science in Hearing and Its Disorders. Unfortunately Hugh died just before the dedication ceremony. The gifts and bequest support a substantial part of the basic research and teaching in audiology at the Center. The Center includes the Leadership Fund, the Hugh Knowles Prize, and two chairs focusing on the relation of audiology to medicine and to engineering.

Colleagues routinely describe Hugh Knowles as very honorable, a great friend, modest, demanding of himself as well as of others, a wonderful man to work for, very kind and thoughtful of others, generous, discreet, meticulous in choice of words, and tactful. Those who knew him mourn his loss. Millions of hearing aid users benefited from his work. The world needs more like him.


Wesley A. Kuhrt

Wesley A. Kuhrt

1917-1988

By Anthony J. Demaria

Wesley A. Kuhrt (fondly known as "Wes"), a long-term pioneer in the nation's aerospace industry, died October 19, 1988, in a car accident in Bloomfield, Connecticut, at age seventy.

He retired from United Technologies Corporation (UTC) in 1982 as senior vice-president-technology after forty-two years with the company. He continued to serve the company during his retirement as a consultant and a representative to the board of directors of Westland, a British manufacturer of helicopters. UTC became part owner of Westland in 1986.

Mr. Kuhrt held a number of increasingly responsible positions with UTC. He served as director of research of UTC's Research Center from 1964 to 1967; president and executive vice-president of Sikorsky Aircraft from 1968 to 1974 and from 1967 to 1968, respectively; and vice-president-technology with UTC from 1974 to 1979. His technical leadership role was vital in keeping UTC at the cutting edge of aerospace technology as well as in fields that were new to the corporation.

For almost two generations, he played an instrumental role in creating, formulating, and administrating research programs in gas turbine engines, rocket propulsion, nuclear propulsion, space nuclear power, high-power lasers, boron filaments, composite materials, propellant chemistry, and fluid mechanics. In 1984 the UTC board of directors and senior management honored him by naming a new optics facility in West Palm Beach, Florida, the Wesley A. Kuhrt Optics and Applied Technology Laboratory.

Mr. Kuhrt was born in 1917 in New Haven, Connecticut, and grew up in Longmeadow, Massachusetts. He entered the Massachusetts Institute of Technology in 1935 and graduated with a B.S. and M.S. in aeronautical engineering in 1939 and 1940, respectively. He joined Pratt & Whitney Aircraft Division in 1940 and in early 1941 transferred to United Aircraft Research Laboratories (now United Technologies Research Center).

Due to diabetes, he was not able to join the armed services during World War II. He married Elaine Mae Jensen in 1946. They had three sons and two daughters. Mr. Kuhrt was a religious man and attended several different churches throughout his life. About 1978 he and his wife started a church in their home in Avon, Connecticut, along with four other couples. From this beginning the Valley Community Baptist Church in Avon was built, and between four and five hundred people now attend weekly services.

He enjoyed building things with his hands and had an extensive tool collection. He and his wife also enjoyed vacationing in Hawaii during the winter and the Adirondacks during the summer, and he played tennis and enjoyed golf. He was a devoted family man.

Mr. Kuhrt served in various capacities at the Research Laboratories, becoming chief of research activities in 1958, assistant director of research in 1963, and director of research in 1964 with overall responsibility for the direction and management of United Aircraft's central research organization. Under his leadership from 1958 to 1967, when he left to become executive vice-president of Sikorsky Aircraft, the Research Laboratories underwent dynamic program content growth and facilities expansion. The staff increased by approximately 30 percent, the floor space quadrupled, and program emphasis shifted from a sole focus on mechanical engineering and aerodynamics to solid state physics, plasma physics, lasers, electromagnetics, microelectronics, material sciences, and advanced computing.

At Pratt & Whitney Aircraft, he made original contributions to the technology of air-cooled reciprocating aircraft engines, particularly with regard to supercharger systems, cooling requirements, and the interrelated thermodynamic effects of cooling and power output. During his early years at the Research Laboratories, he continued to make original contributions in the field of ejector cooling and other sophisticated concepts for advanced high-power reciprocating engines, including the use of cooling fans for the B-35, B-36, and P-47N aircraft and for helicopter engine installations.

He was instrumental in formulating and administering early gas turbine research programs at the Research Laboratories and in transferring this technology to Pratt & Whitney Aircraft Division. He was subsequently responsible for advanced research programs on axial-flow compressors, turbines, afterburners, and other axial-flow jet engine components that, in part, formed the basis for Pratt & Whitney's successful development of the twin-spool J-57 jet engine. He also helped establish the Research Laboratories gas dynamics laboratory, which has continued to serve the corporation since 1947.

Mr. Kuhrt was responsible for the administration of ramjet programs at United Aircraft Corporation (now United Technologies Corporation) and made original contributions to the design and evaluation of these propulsion systems. He also organized the original studies of nuclear engine cycles for aircraft propulsion. He also made significant contributions to studies of boron hydride fuels and to Air Force programs evaluating the feasibility of liquid-hydrogen fuel cycles that took advantage of the unique thermodynamic properties of hydrogen for optimizing propulsion system weight and specific power output. These efforts stimulated his invention in 1957 of a related cycle for a regeneratively cooled liquid hydrogen-oxygen rocket engine in which gaseous hydrogen generated by the nozzle cooling process is used to drive the propellant pumps. This pioneering concept formed the basis for the design of the Pratt & Whitney Aircraft RL-10 rocket engine, which has proven to be uniquely successful on the Centaur space vehicle.

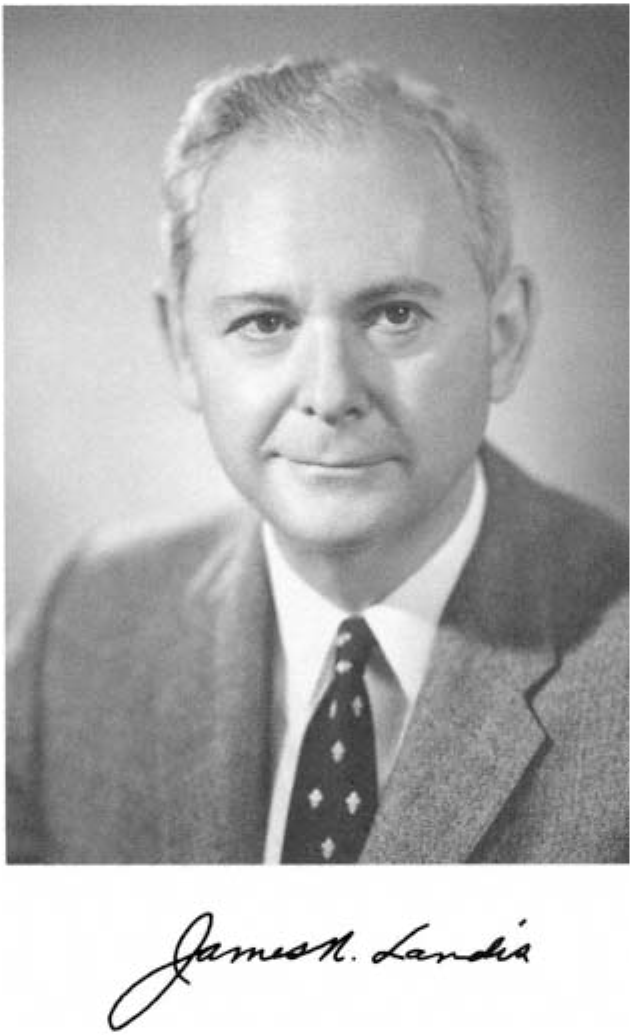
He also was instrumental in establishing and implementing the Research Laboratories' program on gas-core nuclear rockets. In the mid-1960s he established programs at the Research Laboratories for investigating high-power lasers, boron filaments, and composite materials.

Based on the original laser activity carried out by the Research Laboratories, the Pratt & Whitney Aircraft Division entered the design and development of high-power gas dynamic lasers and electro-optics system. The United Technologies Optical Systems organization, now under the Hamilton Standard Division of UTC, is the result of this early electro-optics system effort.

At Sikorsky he applied advanced technology in helicopter designs to improve the basic performance of these aircraft. These design techniques improved helicopter maintainability and reliability with a significant reduction in cost of ownership. Based on this effort, the Sikorsky UTTAS helicopter won for the company multibillion dollar contracts under the Army/Navy helicopter program. Under his guidance a new level of aerodynamic performance was made possible with the use of titanium spar and composite blade structure.

Mr. Kuhrt served on the board of trustees of Barrington College, Barrington, Rhode Island, and Northern Energy Corporation of Boston, Massachusetts. He was a member of the EPCOT Energy Advisory Committee; board of governors of the National Space Club; and the Subcommittee on Technology Policy (Research and Policy Committee) of the Committee for Economic Development, Washington, D.C. He also was a member of the American Helicopter Society, American Association for Advancement of Science, Army Aviation Association of America, National Space Club, National

Aeronautic Association, Navy League of the United States, and American Defense Preparedness Association. For his many technical contributions, he was named a fellow of the American Institute of Aeronautics and Astronautics and in 1980 elected a member of the National Academy of Engineering.


James N. Landis

James N. Landis

1899-1989

By John R. Kiely

Jim Landis, a founding member of the National Academy of Engineering and a noted power engineer, died of cancer on April 29, 1989, at age eighty-nine.

Landis's active engineering years spanned the period from the time of small, low-pressure fossil steam units to the time of very large, high-pressure fossil units and large nuclear units. He was an outstanding mechanical engineer, and he played a major role in technical developments of steam power in this period.

Born in Champaign, Illinois, on August 18, 1899, Landis was an only child. His family lived in Danville, Indiana, during his high school years. Here he was a classmate of his future wife, Lucile Nichols. In 1922 Landis received his B.S. in mechanical engineering from the University of Michigan, where he was elected to the engineering honor societies Tau Beta Pi and Sigma Xi. Upon graduation he and Lucile, also a 1922 graduate of the university, were married.

Shortly after graduation, he went to work for Brooklyn Edison Company as a mechanical engineer researching the design and the equipment for the new Hudson Avenue Generating Station and other plants. From 1929 to 1932, he administered the civil, structural, and mechanical engineering and the layout for all Brooklyn Edison generating stations. During this period, the Hudson Avenue Station became the world's largest generating plant with 770,000 kilowatts of capacity. Two of its units, rated at 160,000 kilowatts each, were the largest single-shaft turbine units ever built. In 1932 Landis became the mechanical engineer of Brooklyn Edison in complete charge of the civil, structural, and mechanical design.

When Brooklyn Edison and Metropolitan Electric Utilities combined into Consolidated Edison, Landis headed a new contract and inspection department. He then became responsible for the civil, structural, and mechanical engineering layout and electrical drafting for all Consolidated Edison power system installations.

This period covered a transition of some installations from direct current and some from twenty-five-cycle alternating current to sixty-cycle alternating current that was standard for all modern generating stations in the United States. Also during this period, modest-sized, high-pressure steam boilers became available. The addition of topping units to existing low-pressure stations increased the station capacity and significantly increased the overall efficiency of the plants. Eventually, single large high-pressure boilers and turbines were developed. During these years, Landis had developed an outstanding reputation in the power industry.

World War II placed additional demands on all war-related industry. For Landis this meant ensuring Consolidated Edison's engineering responsibility for the wartime power needs of Metropolitan New York while also working with the War Production Board in Washington on power requirements of the United States and its allies.

After the war, the power generator field became a major area for engineering and construction. The Bechtel Corporation was adding to its power design group in order to meet the coming surge in demand for electricity. Stephen Bechtel, acting on the recommendation of several top utility executives, offered Landis the position of chief power engineer to have charge of steam plant design for Bechtel. Landis accepted, and in 1948 he joined Bechtel in San Francisco. Here he organized the steam plant design group to handle the expanding load of steam units for such companies as Pacific Gas & Electric, Utah Power & Light, Southern California Edison, and many others.

By 1951 the use of the peaceful atom for steam power had become a subject of great interest. Under President Eisenhower's direction, it was decided to make available to industry the nuclear knowledge involved in the weapon reactors.

A group of utilities and Bechtel formed the Nuclear Power Group and offered to finance its own costs to study the nuclear weapon reactors and make a preliminary power plant design. Jim Landis was one of the key people from Bechtel to participate in this study.

By 1953 Landis had become a vice-president of Bechtel. The Nuclear Power Group Inc. was ready to spend the money to develop the design of a 200,000-kilowatt plant for Commonwealth Edison at Dresden, Illinois, with a General Electric nuclear energy supply.

In 1955 General Electric offered Commonwealth Edison a fixed price for the Dresden plant based on Bechtel's offer to fix the price of the non-nuclear portion of the plant. Commonwealth Edison accepted, and Landis was launched into the real world of nuclear power.

Nuclear power and fossil power design and construction were moving rapidly, and Landis was deeply involved until his retirement from active management in September 1964. He continued to consult actively as an executive consultant and as a vice-president of Bechtel Nuclear Corporation until September 1974.

Throughout his life, Landis strongly supported activities of engineering societies. In particular, he participated in section, technical, and administrative aspects of the American Society of Mechanical Engineers (ASME). He was chairman of the Metropolitan Section of New York, 1933-1935, and of the San Francisco Section, 1955-1956. He became a fellow of ASME in 1954, was elected president of ASME in 1957, and made an honorary member in 1964. His wife, Lucile, was active in the ASME Women's Auxiliary, serving a term as its president in 1947.

As a director and president in 1961 of the Engineers Joint Council, a federation of engineering societies, Landis was able to express his interest in strengthening and unifying the voice of engineers. The culmination of Landis' desire to give the engineering profession national stature and visibility was the establishment of the National Academy of Engineering. He was a member of the Committee of Twenty-Five for founding the Academy and a founding member.

Landis was chairman of the United States Committee when the World Power Conference met in Melbourne, Australia. He served actively as a member of that committee for several years.

Landis was a charter member and a fellow of the American Nuclear Society, a member of the Prime Movers Committee of the Edison Electric Institute, and while with Consolidated Edison a member of the Power Generation Committee of the Association of Edison Illuminating Companies.

Landis had a very active interest in technical developments of the power industry. He published numerous papers that were presented at various universities, ASME meetings, and association meetings worldwide. In recognition of his many contributions to the engineering community, Landis was awarded the Franklin Institute's Newcomen Medal in 1978. In 1977 he was the first recipient of the ASME's James N. Landis Medal, given for "outstanding personal performance in nuclear and fossil power stations, coupled with humanitarian pursuits in his profession."

In addition to Lucile, Jim is survived by his son, James Philip married to Else Molvig; and two daughters, Priscilla Jean married to Lloyd Jackson Moulton, and Janet Lucile, widow of Nobel Laureate Luis Walter Alvarez.

Jim and Lucile led quite an active life in retirement at Rossmoor, Walnut Creek in the San Francisco Bay Area. They especially enjoyed square and ballroom dancing, and they travelled extensively in the United States. They maintained a strong interest in cultural activities and went on many Elderhostel trips to such places as Olympic National Park for five days of study and recreation. Such an active life probably contributed to Jim's longevity and Lucile's continuing active life.

Francis Lawrence LaQue

1904-1988

By Allyn Vine

Francis LaQue died at his home in Kingston, Ontario, on January 19, 1988, at age eighty-three. He was a world-renowned authority on marine corrosion, an outstanding author and lecturer, a prominent business executive, and a consultant and adviser to government. The recipient of many honors and awards, he served as president of the Electrochemical Society from 1962 to 1963, of the American Society for Testing Materials in 1959, and of the National Association of Corrosion Engineers in 1948. He was always known as Frank LaQue.

While a U.S. citizen through most of his professional career, he later returned to Canadian citizenship and was elected to the National Academy of Engineering in 1985 as a foreign associate.

Frank LaQue was born in Gananoque, Ontario, and attended schools there. Being a child when his father died, Frank knew the extra work and responsibility required to help his mother Agnes Mary (O'Neil) and his sister, Mary, maintain the family. In school he liked both academics and hockey and did well in both, thus demonstrating his lifelong characteristics of high standards, dedicated application, and personal enjoyment. His excellent school record helped him into Queen's University in nearby Kingston, Ontario, where he graduated in 1927 with a degree in chemical and metallurgical engineering. After graduating he worked for several months at Deloro Smelting and Refining Company of Canada as a foreman in charge of refining cobalt oxide. Soon, however, he was contacted by the International Nickel Company of Canada, Ltd., commonly known as INCO, and for eleven years was assistant director of technical services. In 1938 he was promoted to the Development and Research Division. In 1940 he was placed in charge of the Corrosion Engineering Section. In 1945 he became vice-president and manager of the Development and Research Division. In 1954 he became vice-president in charge of the Executive Department, and from 1952 to his retirement in 1969, he was a special assistant to the president. Hence, in his forty-two-year career with INCO Frank became well acquainted with many aspects of the research, manufacturing, and usage of materials exposed to the elements.

Perhaps one of Frank's greatest achievements was to establish at Kure Beach and Wrightsville Beach, North Carolina, a large and effective marine corrosion test site. This major effort began around 1935 when Frank received permission to immerse alloy test specimens in the canal supplying ocean water to the bromine extraction plant of the Ethyl-Dow Chemical Company. The test site was soon enlarged to include an area along the beach for testing exposure to marine atmospheres. Eventually, permanent buildings were erected at nearby Wrightsville Beach. The new facility made it possible to house thousands of test specimens, and evaluate corrosion resistance performance of entire engineering installations such as those used for desalination, distillation, and condensing. Results of the various tests were of interest to many engineers and scientists. Accordingly, from the very start Frank arranged an annual inspection and review of the specimens, including presenting his interpretation of the results and inviting others to express their opinions. Employing his unusual wit and tact, he expertly guided divisive opinions to reasonable accord. These popular sessions, attended by several hundred participants, became known as the Sea Horse Institute. They continue today, under the direction of W. W. Kirk, at the same site that is now officially entitled "The LaQue Center for Corrosion Technology."

Thirty-seven years after receiving his B.Sc. in metallurgy from Queen's University, it conferred on him the honorary doctor of laws degree. He served on the visiting committees of the Department of Metallurgy at the Massachusetts Institute of Technology, Case Institute of Technology, Division of Electrochemistry at the University of Pennsylvania, and National Bureau of Standards. Frank was very active in professional groups that were concerned with corrosion. His participation in such groups included being chairman of the Corrosion Research Council from 1959 to 1960; president of the Electrochemical Society in 1962 and of the National Association of Corrosion Engineers in 1949; fellow of the American Society for Metals; vice-chairman of the Welding Research Council; and a member of the Society of Automotive Engineers, the Society of Naval Architects and Marine Engineers, and the American Chemical Society.

After retirement from INCO Frank found time to accept invitations worldwide to present lectures on corrosion and to conduct special courses on marine corrosion at Scripps Institution of Oceanography at La Jolla, California, from 1970 to 1976 and at the University of Hawaii. He served on the board of the International Oceanographic Foundation. Over the years he inspired, advised, and informed many students engaged in corrosion studies and he unstintingly helped numerous engineers concerned with corrosion problems.

In describing the state of our knowledge of corrosion, Frank once stated, "the degree of experience one has with corrosion often determines his opinion of it. Neophytes may believe they understand the corrosion problems they have observed and feel capable of dealing with any similar future recurrences. Experts may suggest rational explanations for apparently anomalous behavior and thus view corrosion as a reasonably orderly phenomenon. But corrosion engineers, like economists, know enough to provide plausible explanations of what has happened without being equally adept at predicting future occurrences."

Frank also spent a very large part of his corporate and retired career improving engineering standards. As with corrosion, his interest was both national and international. He belonged to many engineering standard organizations, did more than normal homework, and became president of several including the American National Standards Institute (ANSI) from 1969 to 1971 and the American Society for Testing Materials (ASTM) from 1959 to 1960. In 1974 he served in Washington as deputy assistant secretary of the U.S. Department of Commerce concerned with industrial standards.

Frank was the 1976 recipient of ANSI's Astin-Polk International Standards Medal that appropriately stated his contributions.

> No American has held offices of higher responsibility in international and national standardization or discharged those responsibilities with more statesmanlike diplomacy or greater vision and wisdom. As president of the International Organization for Standardization, the American National Standards Institute, and ASTM, vice-president of the Pan American Standards Commission, and deputy assistant secretary of commerce for product standards, he worked tirelessly to ensure that standardization programs met the needs of all sectors of society. The wide support he achieved for voluntary standardization and the long range planning he helped institute will assist national and international organizations to continue to make lasting contributions to the worldwide exchange of technology and the well-being of people everywhere.

Frank received other special professional recognitions including the Frank Newman Speller Award in 1949 from the National Association of Corrosion Engineers, the Howard Coonley Medal in 1962 from the American National Standards Institute, the Edward G. Acheson Medal in 1968 from the Electrochemical Society, the Leo B. Moore Medal from the

Standards Engineering Society, the Arch T. Colwell Cooperative Engineering Medal from the Society of Automotive Engineers, and honorary membership in the American National Standards Institute.

Frank's special publications included the Edgar Marburg Lecture on Corrosion Testing, *Proceedings ASTM,* Vol. 51, 1951; coauthor with H.R. Copson, Monograph 158, *Corrosion Resistance of Metals and Alloys,* Reinhold Publishing Co., New York, 1963; *Marine Corrosion,* The Electrochemical Society Monograph Series, John Wiley and Sons, New York, 1975; and the narrative and production of the motion picture *Corrosion in Action,* International Nickel Co., 1955.

Many people will remember and benefit from what Frank LaQue accomplished. However, those who were fortunate enough to know him and work with him may be most apt to remember him for his good humor and forceful, interesting, and effective style; his ability to gracefully shift from dead seriousness to puckish humor; and his intolerance for those who tried to deflect a serious discussion and his helpful tolerance for the serious learner.

Francis Lawrence LaQue influenced to our benefit several professional areas covered by his diversified interests. As a respected, concerned person, generous in all respects, he upgraded life in the community in which all of us live.

Joel Franklin Monroe (Levi) Leathers

1920-1987

By Raymond F. Boyer with assistance from numerous others

Joel Franklin Monroe (Levi) Leathers, considered to be among the world's outstanding process engineers as well as a great innovator in research, pilot plant, production, and management, died June 1, 1987, at the age of sixty-seven. Levi Leathers spent his entire career with Dow Chemical Company, where in 1941 he began as a second-class oiler in the power house of the old Texas Division and in 1976 was named vice-president of Manufacturing and Engineering Technology, assuming worldwide responsibility for ensuring the coordinated development and use of Dow's most advanced manufacturing and engineering capabilities. As he is described affectionately, Levi Leathers was the genuine article, a bear of a man whose accomplishments loomed larger than life and whose brilliant mind led to major improvements in Dow's manufacturing operations. As Levi liked to say, "If it doesn't work, there is a reason why. If it does work, there is a way to make it work better."

Born and raised in Guy's Store, Texas, Levi received his B.S. in chemistry in 1941 from Sam Houston State University, Huntsville. He then joined Dow in the Power Department of the Texas Division in Freeport, Texas, and later that year transferred to Dow's Central Laboratory at Freeport as a control chemist. Between 1943 and 1945 he worked in several Texas Division laboratories as a chemist, and from

1945 to 1947 he held a variety of Texas Division technical management positions including project leader, assistant plant superintendent, and assistant laboratory director. Continuing on at the Texas Division, Levi was named director of the Organic Pilot Plant Laboratory in 1954, director of Research and Development in 1961, and general manager of the Texas Division in 1966.

Then, as it is said, Texas wasn't big enough to hold Levi. He became director of operations for Dow Chemical U.S.A. in 1968, a Dow Company vice-president in 1970, a member of the board of directors in 1971, and executive vice-president of Dow U.S.A. in 1971.

In 1978 Levi was elected to the National Academy of Engineering for his "leadership in large-scale chemical processes which advanced the U.S. chemical industry into a world leadership position." He was also a member of the American Chemical Society, American Institute of Chemical Engineers, Society of Chemical Industry American Section, and Technology Assessment Advisory Council of the Office of Technology Assessment. In 1972 he was presented an honorary doctor of engineering degree from Michigan Technological University, Houghton, Michigan, and in 1977 a Distinguished Alumnus Award from Sam Houston State University.

He served as a member of the boards of directors of Cordis Dow Corporation of Miami, Florida, a Dow associated company; the Missouri Pacific Railroad Company of St. Louis, Missouri; and the Magma Power Company of Los Angeles, California. A. L. Johnson, president of Magma, recalls Levi's broad range of concerns for chemical engineering and power generation. Before Levi served on the board of directors of the power company, which was located in the Imperial Valley of California, hot brine (with 200 parts per million of dissolved salts) was pumped from the earth and flash evaporated to produce steam for power. Levi was especially challenged by the attendant corrosion problems, and Johnson considered Levi a tremendous technical asset to

Magma's operations. One of their power plants is named "The J. M. Leathers Plant."

During the period 1959 to 1977, Levi was the inventor or co-inventor for eight U.S. process or apparatus patents assigned to the Dow Chemical Company. He always longed for the Texas-size challenge. When it came, he was ready. In 1973 he took on the energy crisis with his war on British thermal units. Under his leadership, Dow technology not only survived the crisis but also emerged leaner and more competitive.

Fellow board member H. D. Doan, a grandson of H. H. Dow and former president of Dow Chemical, knew Levi for over thirty years and described Levi as the most dedicated man he had ever met. He noted that we are all better off if we believe in something bigger than we are—religion or country or home. He said, for Levi it was Dow. Levi loved his wife, Katie, and his children. He also loved Dow. He had an instinctive rapport with people who put Dow above themselves. That was a requirement—and he did not think that was very complicated.

It is Dow's strategy to be the best in commodity chemicals and to add to that base several specialty lines. That strategy is proclaimed at the top, but it is in reality a reflection of Levi's leadership in process work that allowed others to adopt it. It also was Levi and Ben Branch, retired head of Dow International and president of Dow Chemical Company, who pushed that process work all over the world so that today that strategy is working. That can remain a lesson for us today. It is always genius down below that makes strategy possible—not the other way around. And genius does not care who gets the credit—as long as the work gets done. And that was Levi.

However, a retired engineer who worked closely with Levi at the time when he was general manager of the Texas Division remembers his outstanding characteristic as "a lasting concern for people." Levi realized that personnel in a large industrial organization might have personal problems related to work, home, or individual traits, problems that were counterproductive. This engineer recalled that Levi had a special ability to sense the existence of such problems and would encourage such an individual to talk. He always warned the person seeking his advice that "I can do one of three things: I can help, or I can't help, but I can certainly sympathize."

His colleagues recall his zest for life and friends, which often became apparent at dinner meetings, during business trips, or at other group occasions when he eventually would lead the group in singing, with or without piano accompaniment. Among his favorites were "The Yellow Rose of Texas," "Release Me," and others of that vintage and genre. Life was never dull with Levi around, whether in work or play. He was tough, but he had a heart much bigger than his tough exterior. He did "good" in the best and most real sense of the word.

W. Deming Lewis

1915-1989

By William C. Hittinger

Willard Deming Lewis, a major contributor to communications science and technology and to education, died on April 19, 1989, at the age of seventy-four. He had been president of Lehigh University from 1964 until his retirement in 1982 after an illustrious career of twenty-three years with Bell Telephone Laboratories and Bellcomm, Inc., the Bell System subsidiary devoted chiefly to systems engineering for the National Aeronautics and Space Administration's (NASA) Apollo program. His contributions cover a broad spectrum of technical disciplines—mathematics, microwave communications, digital error detection, and systems engineering—followed by eighteen years of leadership in directing the evolution of Lehigh into a teaching and research institution of national distinction.

Deming Lewis, son of Willard and Constance (Deming) Lewis, was born in 1915 and was a native of Augusta, Georgia. He enrolled at Harvard University at age sixteen, where he earned the B.A., M.A., and Ph.D. in physics. He received two additional degrees at Oxford University, where he was a Rhodes Scholar in advanced mathematics. He was awarded seven honorary degrees in recognition of his contributions to technology and education. He was the father of five daughters by his first wife, Marian Carter Chapman Lewis, who died in 1965, and added two children to his family when he married Emmaline Hoffman in 1966.

In 1941 Deming joined Bell Telephone Laboratories as a member of the technical staff, and rose to executive director of communications systems. He was granted thirty-three U.S. patents on such components and systems as microwave filters, antennas, and digital error detection. He authored many technical articles in his field. He was also responsible for the research efforts of groups of scientists and engineers in advanced telecommunications; much of the research led to newly emerging telephone switching systems that are the main building blocks of today's switched telecommunications network.

When NASA requested the Bell System in 1962 to form a systems engineering organization to guide the Apollo moon landing program, Deming Lewis was one of four technical leaders who built Bellcomm, Inc. and managed this effort to ensure the technical evolution and integrity of the lunar mission.

On October 11, 1964, Deming Lewis was installed as president of Lehigh University. In his inaugural address, Lewis called for broad undergraduate programs to provide a firm understanding of fundamentals, specialized graduate and research training, and continuing education.

Lewis' abilities were much sought after during his career. He was a charter member of the Polaris Command and Communications Committee and the Defense Industry Advisory Committee. In 1964 he was appointed by the Secretary of the Navy to the Naval Research Advisory Committee, which he chaired for two years. He also served as a consultant to the President's Scientific Advisory Committee for the U.S. Office of Science, Research, Development.

He was chairman of Pennsylvania's Board of Education, chairman of the Pennsylvania Commission for Independent Colleges and Universities, and president of the Lehigh Valley Association of Independent Colleges. Also, he was chairman of the council for the Harvard Foundation for Advanced

Study and Research and a member of the Overseers' Visiting Committee for Engineering and Applied Physics at Harvard. He was on the board of governors and was a vice-president of the Harvard Engineering Society. He participated in many community functions as well, including hospital and United Way.

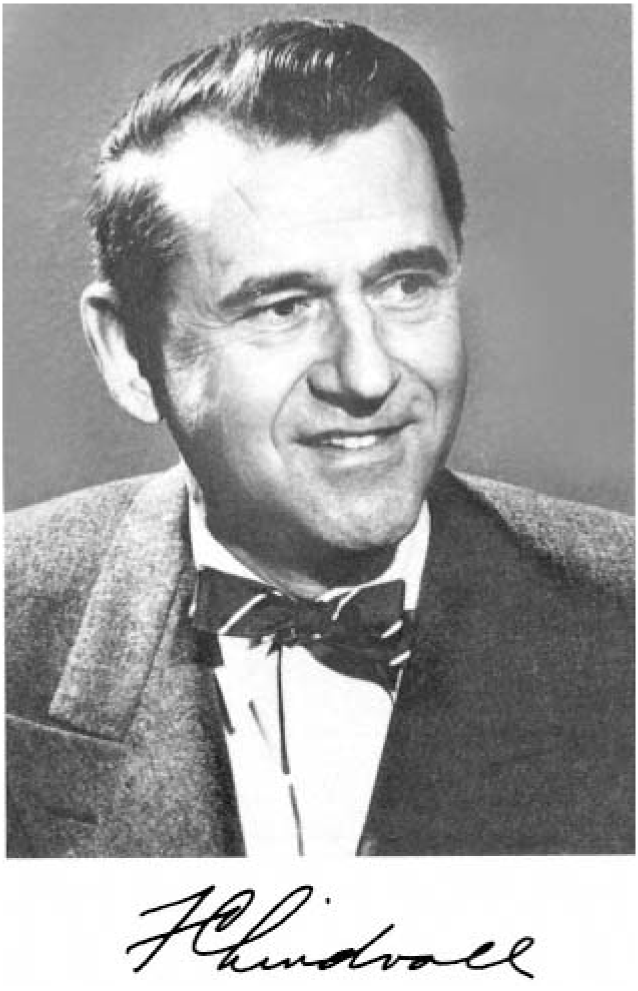
Deming Lewis was elected to the National Academy of Engineering (NAE) in 1967. He was a member of NAE's Executive Committee; he chaired the National Research Council's Space Applications Summer Study and NAE's Committee on Power Plant Siting.

He was a fellow of the Institute of Electrical and Electronics Engineers and of the American Association for the Advancement of Science. He was a member of many learned and technical societies, including the American Physical Society, Phi Beta Kappa, Tau Beta Pi, Sigma Xi, and the American Institute of Aeronautics and Astronautics, Inc.

Industry also sought his council and wisdom through membership on boards such as those for Pennsylvania Power and Light Company; Bethlehem Steel Corporation; Fairchild Industries, Inc.; Fisher & Porter Company; and Zenith Radio Corporation.

Deming's accomplishments reflect in part his many talents and interests. A voracious reader since early childhood and an avid handyman around the house, Lewis rapidly did "The New York Times" crossword puzzle daily and spent weekends during his later Lehigh years designing and building by hand "Capricorn", his family's 35-foot cabin cruiser. He also continued to play his college sports of squash and tennis and presented an imposing, towering challenge to his opponents.

A witty idealist without illusions, he is remembered by his colleagues for his zest for living and the breadth of his interests. To those who knew him well, Deming Lewis was a symbol of integrity. He did not merely advocate scholarship, he was a scholar. He did not preach high ideals; he was their embodiment. In a tribute by his university colleagues, it was said, "all educational institutions are measured by the quality of students they produce. A few are fortunate enough to want to be measured also by the quality of the leaders they nourish. Lehigh is proud to have flourished under the leadership of Deming Lewis, whom it honors and will long remember."



Frederick C. Lindvall

1903-1989

By Ruben F. Mettler

Fred Lindvall was a man of many dimensions, including his long and dedicated association with Caltech, his national prominence in engineering education and the engineering profession, his wide range of engineering research interest, his many cultural and civic interests, and his love for family and friends. In this context, it is my privilege to write of Fred as one of his former students, touching on his role as a teacher, an academic advisor, and a personal friend.

Fred, professor of engineering, emeritus, at the California Institute of Technology, died January 17, 1989, in Pasadena.

He was born on May 29, 1903, in Moline, Illinois, and earned his B.S. from the University of Illinois in 1925 and his Ph.D. in electrical engineering from Caltech in 1928. He worked for the General Electric Company from 1928 to 1930 and joined the Caltech faculty in 1930 as instructor in electrical engineering. Subsequently he became assistant professor of electrical engineering, associate professor, and then professor of electrical and mechanical engineering, and from 1945 to 1969 chairman of Caltech's Division of Engineering and Applied Science.

After retiring as professor of engineering, emeritus, in 1970, Fred became vice-president for engineering at the Illinois-based Deere & Company.

Fred was elected a member of the National Academy of Engineering in 1967. He was also a member of the National Academy of Sciences, a fellow of the Institute of Electrical and Electronic Engineers and of the American Society of Mechanical Engineers, national president of the American Society for Engineering Education and of Sigma Xi, a member of the Engineers' Council for Professional Development and Tau Beta Pi, a director of the Stanford Research Institute, and a consultant for the President's Office of Science and Technology. During World War II, he supervised government ordnance research projects at Caltech and received the Naval Ordnance Development award and the Presidential Citation for Merit.

Fred served as a member of the board of directors of numerous firms and institutions, a member of the Jet Propulsion Laboratory's Advisory Board, and a trustee of Harvey Mudd College. From 1936 to 1953 he was also a lieutenant in the U.S. Naval Reserve.

My first contact with Fred was in the late 1940s when he was in the early years of his long service as chairman of the Division of Engineering and Applied Science. It was an exciting time for Caltech, and for engineering in general, and Fred was in the middle of the action.

He encouraged graduate students to spread their wings—academically and professionally. He emphasized applied science and applied mathematics as the underpinning of modern engineering and encouraged his students to take as many courses as possible in other departments and divisions at Caltech. For many of his students, their first acquaintance with concepts like "interdisciplinary research," "system engineering," and "management of technology" came from Fred. He made it seem very natural for me as an electrical engineer to do a thesis in aeronautics and have an Examination Committee representing a wide range of disciplines, especially in physics and mathematics.

Although Fred emphasized quantitative analysis, he made it clear that in practice, engineering (and especially engineering design) is a decision-making process that can lead by many different paths to an effective solution, but with no exactly right or wrong answers. He made clear the differences between analysis and synthesis.

To this day, I do not need to consult a Caltech catalog to remember the advanced engineering course that Fred personally pioneered and taught, and in which he demonstrated these points. It was EE 226, and more than any other course I took at Caltech, it made a lasting impression on me.

Fred assigned general problems of a practical nature that students had never encountered before, often with a due date one or two months later so there was plenty of time to think about the problems and how to approach them. The student was left on his own and was to determine (and later defend) his underlying assumptions, his approximations, his methods, and the validity of his solution. The fact that the course had an EE label had no constraining influence on Fred's problem selection. I can recall problems that introduced us to long narrow bridges (like the famous Tacoma Narrows bridge), a dam in a canyon with a particular geology, high-voltage transmission lines, rocket motors, and analog computers. The key task was to take the problems all the way to final design solutions, supported by quantitative analysis.

What made this so exciting was that as graduate students we had just been introduced in our candidacy courses to the "magic" of Laplace transforms, the incredible scope and beauty of Maxwell's equations, the power of vector analysis, and the mysteries and uncertainties of fluid mechanics. Fred's course helped us begin to understand how practical engineering solutions could be developed from such abstract theories and analytical techniques if we could add enough common sense and engineering judgment.

After several years that had been like drinking out of an intellectual fire hose, we were able to sip and taste some of the water.

As one of Fred's students, I wish to salute and honor him as a giant of the engineering profession, one of Caltech's finest, and a trusted adviser and friend.

John Routh Low, Jr.

1909-1988

By J. E. Burke and L. F. Coffin

John Routh Low, Jr. was born in Washington, Pennsylvania, near Pittsburgh, on February 19, 1909. In 1937 he married. His wife, Dolphia, and he had three children: John R. Low III, Susan Low Laing, and Richard A. Low. He died in Belair, Maryland, on August 28, 1988, and his wife and children all survive him.

Jack's early exposure to the metallurgical atmosphere of the Pittsburgh neighborhood had an effect: he worked in the field of metallurgy all his life. He entered the Department of Metallurgy and Mining Engineering at Purdue University in 1927, and received his B.S. from there in 1931. Upon graduation he worked as a metallurgist and mill foreman, for Keystone Steel and Wire Company for two years and for Republic Steel Corporation until 1938, when he entered Carnegie Institute of Technology in Pittsburgh as a Carnegie Illinois Steel Company fellow. He received his doctor of science degree in metallurgy in 1943. Upon graduation, he joined the metallurgy faculty of Pennsylvania State University as an assistant professor, and was a professor and head of the Metallurgy Division from 1945 to 1948. Through the war years of 1944 and 1945, he also worked on government projects in the laboratories of the Carnegie-Illinois Steel Company in Pittsburgh, and there first became involved with the fascinating, and tremendously important, problem of brittle fracture of ship plate. During that period, many of the all-welded Liberty Ships sustained severe fractures upon entering colder waters. Sometimes the fractures were serious enough to cause the ship to break in half.

In the period immediately after the war, many people changed jobs, as did Jack. In 1948 he joined the metallurgy group at the Knolls Atomic Power Laboratory of the General Electric Company as head of the research group. There he continued to work on brittle fracture in steel but also investigated the then important problems associated with property changes induced in metals by neutron bombardment and other radiation effects encountered in nuclear reactors. In 1953 he transferred to become a research associate in the Metallurgy Department of the General Electric Company Research Laboratory (now the GE Corporate Research and Development Center). While he continued his interest in brittle fracture, his interests broadened to include study of many dislocation processes in metals.

In 1967 he joined the faculty of Carnegie Mellon University where he continued research and teaching. In 1977 he became professor emeritus, and subsequently lived with his wife in Richmond, Virginia, and Belair, Maryland.

Jack Low played an exceedingly important leadership role in both the science and application of metal deformation and fracture through the years 1940 to 1977, a period when physical and mechanical metallurgy underwent a tremendous forward advance. He has played a major role in that advance, both through his own research and through careful and diligent training of those students fortunate enough to have worked with him. His students particularly remember his low-key, but extremely penetrating review and critique of their work and ideas. He was a recognized authority on the relationship between microstructure and fracture processes in structural alloys, and his publications on such topics as temper embrittlement, the role of inclusions and dispersoids, and cleavage processes in the fracture of high-strength steels and aluminum alloys are universally cited. He was an early investigator of the role of dislocations in deformation and fracture, from which came the concept of dislocation velocity-stress relationship. This led to a clearer insight into the complex behaviors of strain aging and the yield point. His views, which have always been supported by careful and precise experimental evidence, have formed the backbone of our current knowledge of fracture in metals.

A major contribution by Jack Low was through the group that was to become the American Society for Testing and Materials (ASTM) Special Committee E24 on the Fracture Testing of Metals. In response to a request from the Secretary of Defense in 1959, ASTM formed a special technical committee to address the problems being encountered with brittle fracture of high-strength materials used in various missile and rocket motor cases. Jack chaired that committee. Their first two reports emphasized the importance of using the then just-developing analytical technique of fracture mechanics, and it was Jack who clearly presented the advantage of fracture mechanics technology in his preface to the first report issued by the committee. Fracture mechanics is now, of course, a very well-established subdivision of the materials science and technology field.

Jack Low was not only a good scientist, he was a delightful person and had many good friends in the various places he lived. He and his wife Dolphia gave many wonderful and well-remembered parties in Schenectady, where he spent the major part of his career. He was also an ardent golfer, with what was considered to be a beautiful swing, although its beauty was not always reflected in his score. He greatly enjoyed sailing and hated winter. He is missed by his many colleagues and friends.


W. R. Marshall

W. Robert Marshall

1916-1988

By R. Byron Bird, Edwin N. Lightfoot, Dale F. Rudd, and John G. Bollinger

W. Robert Marshall, former dean of the College of Engineering of the University of Wisconsin, died at age seventy-one on January 14, 1988, after suffering a heart attack. At the time of his death he was still quite active professionally and was serving as the director of the University-Industry Research Program. This influential position was a fitting capstone to an impressive career, which included teaching, research, industrial consulting, professional society leadership, and university administration. He spent much of his time at the University of Wisconsin trying to strengthen ties between academia and industry. He was also an effective author, whose books and writings strongly influenced chemical engineering education and research.

Bob Marshall was born on May 19, 1916, in Calgary, Alberta, and came to the United States as a child; he became a naturalized U.S. citizen on March 20, 1944. He was an undergraduate in chemical engineering at Armour Institute of Technology (now called Illinois Institute of Technology), which awarded him the B.S. in 1938. In the spring of 1937 Professor Olaf A. Hougen of the University of Wisconsin was a visiting professor at Armour, and forged a lifelong relationship with Bob, who accompanied Olaf back to Madison for graduate study. In 1941 he received the Ph.D. from the University of Wisconsin based on a thesis entitled "Through-Circulation Drying," done under Professor Hougen's direction.

In 1941 Bob accepted a position in the Engineering Department of the Engineering Experiment Station of the E.I. du Pont de Nemours and Company in Wilmington, Delaware. The du Pont experience played an important role in shaping Bob's professional attitudes—in particular his emphasis on solving real engineering problems, his feeling that science and engineering are equal partners in the advancement of technology, and his concern that research results should be put in such a form that they will be of direct use to the practicing engineer.

During his stay at du Pont Bob served as an instructor in the evening program of the Extension Division of the University of Delaware. This led to his collaboration with Professor Robert L. Pigford on the book *The Application of Differential Equations to Chemical Engineering Problems,* which was published in 1947 by University of Delaware Press. This book was extremely influential because it was richly illustrated with imaginative and important problems, many of which even today provide excellent examples of how mathematics can be used to solve problems of engineering interest.

In 1947 he was once again attracted to the University of Wisconsin by Olaf Hougen, where he was given an appointment as associate professor of chemical engineering. His teaching activities included a new graduate course on applied mathematics (based on his book) and the graduate course on mass-transfer operations, which he revitalized by introducing new ideas based on transport phenomena and boundary-layer theory. His research program took shape quickly, and he soon had a rather large graduate group working on a wide variety of drying processes. He and his students made major contributions, particularly in the areas of atomization and spray drying, and for some time he was referred to as "the founder of modern spray-drying technology." All in all Bob directed the Ph.D. theses of thirty-two graduate students, most of whom have made substantial professional contributions.

In 1954 his famous monograph *Atomization and Spray Drying* appeared as the second volume of the Chemical Engineering Progress Monograph Series, published by the American Institute of Chemical Engineers. This monograph summarized his seven years of research at du Pont and six years of research with his students at the University of Wisconsin. In this book Bob showed how applied mathematics, fluid dynamics, transport phenomena, statistics, and physical chemistry could be used to solve critical problems in spray processing, and that this could be done in such a way as to obtain workable design methods and performance characteristics of spray dryers. In 1981 a practicing engineer in a large U.S. industry said of Bob's monograph, "Using many of the principles described in this publication, we have improved equipment capacity nearly tenfold with accompanying major improvements in costs. When you consider that we produce approximately two billion pounds of spray-dryed products annually, these improvements were and are of obvious economic value." Bob was an early practitioner of "engineering science" in the best sense of that term. His work was the basis of industrial processes that were to produce billions of pounds of products every year.

Although Bob was a gifted teacher and a brilliant research supervisor, he was soon asked to transfer his talents to help solve administrative problems. In 1953 he was appointed associate dean of the College of Engineering and executive director of the Engineering Experiment Station. In this capacity Bob was able to combine his originality and enthusiasm to bring about a number of changes. He chaired the committee that led to the establishment of the Department of Nuclear Engineering, which included both graduate and undergraduate programs. Along with Farrington Daniels he established the Solar Energy Laboratory. He was also instrumental in the development of the Materials Science Program. He was directly responsible for setting up a lively exchange program with Monterrey Institute of Technology in Mexico, and also a student exchange between the University of Wisconsin and universities in West Germany.

In 1971 Bob was named dean of the College of Engineering, a post that he was to hold for ten years. In this position he was able to continue being creative in an administrative way. His strong belief that engineering opportunities should be open to women and minorities led to the creation of one of the first student programs for minorities in engineering in the country. He also encouraged the involvement of College of Engineering faculty members in the Development Program for the Institute of Technology at Surabaya in Indonesia; this involved the building of a new campus and providing postgraduate training for the engineering faculty. His concern for the inability of engineers to be effective in the political and public service arenas led him to establishing courses in the General Engineering Department dealing with the interaction of engineering and society. He also gave positive encouragement to the development of the first instructional program on technical Japanese translation in the United States, and set up a mechanism for faculty and student exchange between the chemical engineering departments of the University of Wisconsin and Kyoto University.

After retiring from the deanship in 1981, Bob accepted the assignment of director of the University-Industry Research Program. In this capacity he found new opportunities to put his experience and leadership to work by facilitating and supporting faculty research relationships with industry. Bob concerned himself with the diversity of research activities on the entire campus and the possible beneficiaries of this research throughout the state. He worked on such problems as patent advice for professors, small business development, and sources of external research support.

Bob Marshall was an enthusiastic supporter of the American Institute of Chemical Engineers (AIChE) and had a keen sense of responsibility to the organization. He accepted numerous committee assignments and was the primary force in establishing the Continuing Education Committee, which he chaired from 1964 to 1967. He served as director from

1956 to 1958, vice-president in 1962, president in 1963, past president in 1964, and treasurer from 1976 to 1980. The institute recognized his research and leadership roles by bestowing on him many awards and special recognitions: Institute Lecturer in 1952, William H. Walker Award in 1953, Professional Progress Award in Chemical Engineering in 1959, and Founders Award in 1973. In 1983, on the occasion of the Diamond Jubilee of the AIChE, he was included in the list of thirty "Eminent Chemical Engineers" in the United States.

In addition to participation in the AIChE, Bob also served on seven committees of the American Society for Engineering Education, including the Black Engineering Colleges Development Committee and the Professional Development Committee of the Biomedical Engineering Division. For Argonne National Laboratory he served as chairman of the Chemical Engineering Review Committee and as member of the Policy Advisory Board. He was very active in the Associated Midwest Universities organization, serving on the board of directors and as vice-president in 1961 and 1962 and as president in 1962 and 1963. He had a three-term stint on the Executive Committee of the Engineers Joint Council and served for two years as vice-president of that organization.

In addition to the awards he received from the AIChE, Bob Marshall was accorded many other honors, including fellow of the American Academy of Arts and Sciences in 1960, the Gold Medal of the Verein Deutscher Ingenieure in 1974, and an honorary doctor of laws from the Illinois Institute of Technology in 1981. From his own College of Engineering he received the Ragnar E. Onstad Award for Service to Society in 1981, and the Byron Bird Award for Excellence of a Research Publication in 1983.

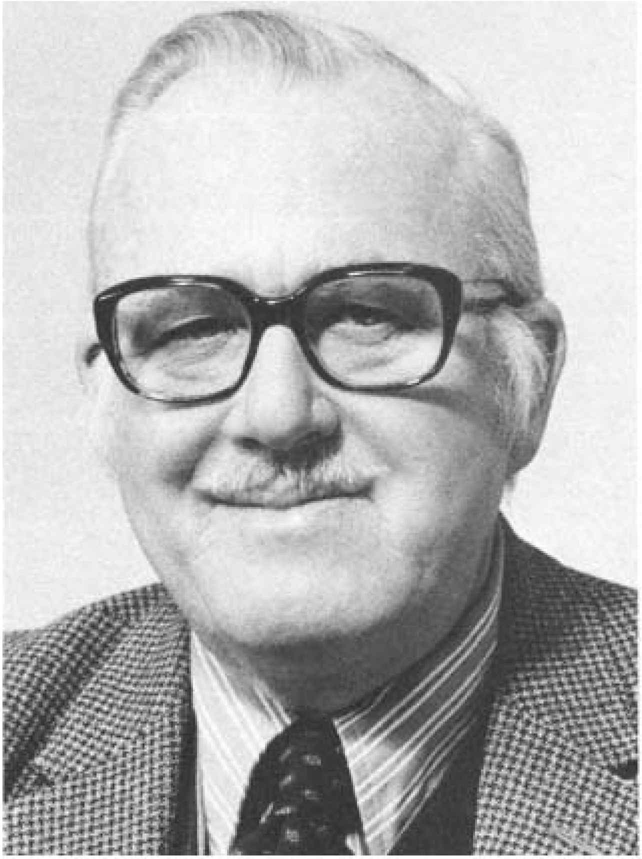
Election to the National Academy of Engineering (NAE) came in 1967. Within the NAE he served on the Commission on Education, of which he was vice-chairman in 1969 and chairman from 1970 to 1974. He also was a member of the

Committee on the Interplay of Engineering with Biology and Medicine from 1968 to 1973, and served as chairman from 1969 to 1973. In addition he was on the Committee on Membership from 1968 to 1970.

Bob was always professional and gentlemanly. He was devoted to providing the best possible opportunity for his colleagues and students to deploy their talents and energies to maximum effectiveness. It came naturally to him to convey to others his enthusiasm for their skills and potential, and he provided them with the chance to present their ideas and hopes in a supportive setting. He never assumed any credit for their contributions. He simply wanted his associates to be able to attain their goals. Many people owe their own professional success to words of encouragement from Bob Marshall. He was always available to his friends and colleagues when they needed help or advice.

In addition to his university and professional activities, Bob found the time to support the community in which he lived. He was a member of the school board in Monona, Wisconsin, for six years. He was vice-president of the Madison Downtown Rotary Club from 1984 to 1985, and he served as a member of the board of directors of United Way from 1981 to 1982.

Bob was a very genuine and modest person, and despite his exalted standing in the professional world, he was never ostentatious or condescending. He always gave his very best efforts to every task that he undertook; but he did more than that—his performances always had a sense of "style" and "flair" that few others can attain. Whether he was chairing a committee, making a technical presentation, or giving a eulogy at a memorial service, Bob could supply a little extra spirit or warmth or humor that would upgrade the performance from excellent to superb. He left his colleagues, friends, and family a remarkable legacy of accomplishments, inspiration, and high principles.



Stanley G. Mason

1914-1987

By Howard Brenner

Stanley George Mason, a prominent Canadian colloid scientist and one of the founders of the science of microrheology, died unexpectedly on April 21, 1987, in Grand Mere, Canada, in the Province of Quebec. From 1946 until his retirement in 1979, he was director of the Applied Chemistry Division of the Pulp and Paper Research Institute of Canada (Paprican), housed on the McGill University campus in Montreal, while simultaneously holding an appointment on the McGill Chemistry Faculty. From 1979 to 1985, he was Otto Maass Professor of Chemistry at McGill, achieving the status of professor emeritus in 1985. This last position was endowed with special meaning as Otto Maass was Mason's Ph.D. thesis supervisor.

Stan (as his friends and colleagues called him) was born in Montreal on March 20, 1914, and earned a B.Eng. in chemical engineering from McGill University in 1936, followed in 1939 by a Ph.D. in physical chemistry from this same institution under the supervision of the well-known Canadian physical chemist Otto Maass with whom he conducted research on critical-state phenomena, especially critical opalescence. Following a two-year academic appointment as lecturer in physical chemistry at Trinity College in Hartford, Connecticut, he spent the war years 1941-45 at the Suffield Experimental Station in Ralston, Alberta, Canada, in the role of research engineer and head of the Munitions Division in the Department of National Defence. During 1945-46 he served as associate research chemist with the newly created (Canadian) Atomic Energy Division of the National Research Council in Montreal. He returned to the McGill campus in 1946 to begin an affiliation that continued uninterrupted for the next forty years, ending only with his death.

Stan Mason and his students revolutionized the way in which we think about flowing suspensions and dispersions. These heterogeneous substances, composed of particles dispersed in a fluid, are encountered in fields as diverse as cellulose-fiber suspension in paper-making machines and in the red and white blood cell suspensions coursing through our bodies. Accumulated knowledge regarding the dynamics of such systems constitutes the science of microrheology —a term that Mason coined, and a subject that he and his collaborators pioneered.

Prior to Mason's researches in the field of microrheology, begun in the early 1950s, we were taught that there existed in Nature only four states of matter, namely solids, liquids, gases, and plasmas. It would be only a mild exaggeration to say that Mason and his students taught us of the existence of yet a fifth state of matter—namely suspensions or dispersions, especially those in a state of flow. Together he and his coworkers showed us how the complex, macroscopic, engineering, continuum-level properties of flowing suspensions of colloidal and larger particles dispersed in a liquid could be understood at a much simpler, microscopic, scientific, particulate-scale level of description. Furthermore, they demonstrated how such knowledge could be manipulated so as to serve the needs of *both* engineering and science.

This research was done within the context of attempting to furnish answers to important technological questions, particularly those posed initially by technical day-to-day problems existing within the pulp and paper industry. In his hands, this essentially pragmatically oriented research program spawned activities that were intellectually stimulating, aesthetically pleasing, and posed a constant challenge to experimentalists working at the instrumental frontiers of microrheology, as well as theoreticians working at the corresponding physicomathematical frontiers.

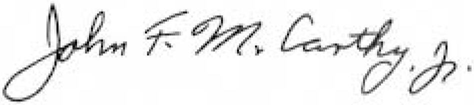
His remarkable success at resolving the dichotomous tensions often existing between proponents of pure versus applied science is reflected in the diverse sources of the awards and honors that came to him during his lifetime. Last, but not least, among these was the prestigious Prix Marie-Victorin (1986)—the highest scientific distinction of the Province of Quebec. Moreover, he was elected a foreign associate of the National Academy of Engineering in 1980, as well as achieving fellowship status in a variety of professional societies including the Chemical Institute of Canada (1950), the Technical Association of the Pulp and Paper Industry (1968), and the Franklin Institute (1980) in addition to being named a distinguished member of the International Society of Biorheology (1984). The American Chemical Society gave him its Kendall Award in Colloid Chemistry (1967) and its Anselme Payen Award in Cellulose Chemistry (1969). The Society of Rheology awarded him the Bingham Medal (1969) and the Franklin Institute the Howard N. Potts Medal (1980). Within Canada, the Chemical Institute of Canada recognized his work with the presentation of the CIC Medal (1973) and the Dunlop Award (1975).

The scientific legacy of any academic researcher is embodied in his research publications—those refereed and invited papers published in scientific journals. Stan was prolific in this sense. Over a 43-year period, beginning in 1940 with his first publication on critical phenomena with Otto Maass, and ending with his last publication in 1983 on the droll subject of the surface tension of solids, he published no less than 271 scientific and technical papers totalling 3,282 printed pages of text and coauthored with approximately 60 Ph.D. students, 20 postdoctoral fellows, and 18 assorted colleagues and visitors. Simple division reveals that this accomplishment averages out to 6 papers (of roughly 12 pages each) published year in and year out for 43 years! And some years were better than others, his "personal best" occurred in 1977 with 18 published papers, at which time Mason was 63 years of age; the year 1981, two years after Stan Mason's so-called "retirement," ran this earlier record a close second with 17 publications.

In addition to their novelty, these 271 publications display a remarkable intellectual tenacity. Themes (embodied in the form of serial publications) were zealously pursued over long periods of time as advances in scientific instrumentation occurred to make possible experiments formerly deemed impossible; new and more detailed mathematical formulations were built upon the foundations laid down by more approximate predecessors in the series. For example, embedded in the overall list of 271 publications is a subsequence of 31 papers spanning a 30-year period. Each bears the same generic title, "Particle Motions in Sheared Suspensions," followed by an appropriate subtitle. The first of this series, coauthored with B. J. Trevelyan and dated 1951, bears the Roman numeral I and is subtitled simply "Rotations." The last in this series, dated 1981 and bearing the Roman numeral XXXI, is accompanied by the much richer subtitle "Rotations of Rigid and Flexible Dumbbells (Experimental)," along with a list of coauthors as lengthy as its title (namely K. Takamura, P. M. Adler, and H. L. Goldsmith). This single 30-year-long serial thrust involved no less than 33 different coauthors, whose names spanned the alphabet from A for Adler to Z for Zia. Equally did their nationalities span the globe.

Further and more detailed summaries of facets of Stanley G. Mason's professional life can be found elsewhere, including his own personal commentary "How I Became Interested in Colloid Science" *(Journal of Colloid and Interface Science,* Vol. 71, pp. 8-10, 1979), which appeared in the Festschrift volume accompanying his McGill retirement. Summaries and commentaries by his former students include an "Appreciation" written by Harry L. Goldsmith and David A. I. Goring in this same Festschrift volume (pp. 1-7). A more recent "Appreciation", penned by his intellectual heir, Theo G. M. van de Ven, appears as an introduction to the S. G. Mason Memorial Issue of the *International Journal of Multiphase Flow,* scheduled for publication in mid-1990.

With his passing, Stanley Mason leaves his wife, Renata, and two daughters, Cheryl and Andrea, as well as a whole host of former students, colleagues, and others whose lives he enriched. We will always remember him with great affection, admiration, and respect.



John Francis McCarthy, Jr.

1925-1986

By William B. Bergen

John McCarthy, a recognized scientist and engineer, died on February 7, 1986. He is remembered for his engineering accomplishments that spanned an unusually broad range and were of considerable significance. Equally important, he was a man known for his willingness to share his knowledge with students and through his many published papers. He was a true contributor in every sense.

Born on August 8, 1925, in Massachusetts, and following military service from 1944 to 1946 and work for Trans World Airlines in Rome, Italy, John enrolled at the Massachusetts Institute of Technology (MIT). There he received his B.S. in 1950 and his M.S. in 1951, both in aeronautical engineering. In 1962 he earned his Ph.D. from the California Institute of Technology.

From 1951 to 1955 John served as project manager in the Aeroelastic and Structures Research Laboratory at MIT where he made major contributions to knowledge in supersonic flutter through his development of techniques for testing in the blowdown tunnel. This work included the design and operation of one of the first variable Mach number supersonic test sections on which he performed some of the earliest successful supersonic flutter tests. He also did extensive research in aerodynamics, loads, aeroelasticity, and vehicle dynamics, being a prolific contributor to the activities of the Aeroelastic Laboratory at a period of its maximum effectiveness.

In 1955 he became an operations analyst at the headquarters of the Strategic Air Command and in 1961 vice-president of research and engineering in the Space Division of North American Rockwell Corporation where he was responsible for the direction and conduct of research, engineering, and test activities. In his work for the Space Division, he was a key figure in the basic design and testing of the Apollo command and service modules and the Saturn S-11 stage of the Saturn V launch vehicle. He envisaged many of the concepts for these projects, which ultimately culminated in the successful manned lunar landings.

In 1971 after the Apollo program, he became a professor in the Department of Aeronautics and Astronautics at MIT and in 1974 director of MIT's Center for Space Research. During his tenure there, the center pioneered in the successful execution of space experiments to investigate the plasma and x-ray properties of outer space.

He then went on in 1978 to become director of the National Aeronautics and Space Administration's (NASA) Lewis Research Center where he was responsible for the effective accomplishment of the mission and support activities of the Center, including aeronautics, space systems and technology, launch vehicles, and energy programs. In addition, as a member of the U.S. Air Force Scientific Advisory Board and chairman of the Aeronautical Systems Division Advisory Group, he played an important role in many Air Force programs. For example, John headed part of the review of the C-5 transport aircraft when previous reviews had identified the wing structure of the C-5 as marginal and questions had arisen in regard to not only safety but also instrumentation, inspection, and anticipated flight hours. John's review group concluded that the aircraft could be safely flown but that extraordinary measures should be taken to ensure a reasonable life expectancy. The H-Mod recommended by the group and adopted by the Air Force for the wing more than tripled the structural life of the aircraft. He also led study groups to identify structural modifications to increase the structural life of the B-52D, F-4, A-10, and KC-135 aircraft.

In 1982 John returned to industry as vice-president and general manager of Northrop's Electro-Mechanical Division.

John was a blend of the scientist and engineer. He was an avid technical writer and delivered many papers (over ninety-two publications) in this country and abroad. In 1981 he was elected a member of the National Academy of Engineering. He was also a fellow of the American Institute of Aeronautics and Astronautics (director 1975-76), associate fellow of The Royal Aeronautical Society, and chairman of the Aeronautical Systems Division's Advisory Group of the U.S. Air Force Systems Command from 1971 to 1978. He was a member of the NASA Research Advisory Committee on Space Vehicle Aerodynamics and NASA Research & Technology Advisory Council-Panel of Space Vehicles; Scientific Advisory Group of The Joint Chiefs of Staff; Scientific Advisory Board of the U.S. Air Force; Research and Development Planning Council of the American Management Associations; executive committee of the American Society for Engineering Education-Aerospace Division; The Society of the Sigma Xi; and Sigma Gamma Tau, national honorary aeronautical society. John also served as a consultant for the Office of Director of Defense Research and Engineering, Office of the Secretary of Defense.

His awards included the Apollo Achievement Award from NASA in 1969, the Award for Meritorious Civilian Service from the U.S. Air Force in 1973, Decoration for Exceptional Civilian Service from the U.S. Air Force in 1978, and NASA's Distinguished Service Medal in 1982.

John's steady dedication to the value of an engineer at the top of the decision process for high-technology products served as an example to us all. His quiet understanding of the new problems involving materials and structures under intense use set up new criteria in both his military and commercial design work that increased the life of critical structures and critical materials by factors of 1.05 to 2.0 or perhaps 3.0 depending on the part and adequacy of its original requirements. However, though his technical contributions were substantial, his major contributions may have been in his ability to lead and inspire other engineers by virtue of his clear insight and technical depth in analyzing engineering problems and his excellent judgment in planning and executing complex engineering tasks.

Otto Neil Miller

1909-1988

By S. D. Bechtel, Jr.

Otto N. Miller, retired chairman of the board and chief executive officer of Chevron Corporation (then Standard Oil of California), died in San Francisco on the morning of February 4, 1988, following a brief illness. He had retired from Chevron in 1974, after serving as the chief executive for seven years (from 1966 to 1974), capping a distinguished career that spanned two generations during a time of tremendous growth and prosperity for the multinational petroleum company. One of the world's largest enterprises, and the largest U.S. corporation west of the Rocky Mountains, San Francisco-based Chevron grew in assets and global stature under the astute guidance of Otto Miller.

During his thirty-nine years with Chevron, Otto Miller demonstrated a rare combination of qualities: technical expertise, a visionary's insight into broad industry trends, a keen sense of when to capitalize on change, and leadership traits that enabled him to advance meteorically into positions of increasing responsibility.

Throughout the petroleum industry, Otto Miller was widely known as a strong executive ahead of his time in recognizing key issues in the public arena as well as bold opportunities in the private sector. His career encompassed virtually all aspects of petroleum operations. When he was named the company's president in 1961, a business magazine characterized him as a member of "the new breed of oil executive, experienced in all facets of the business and charged with coordinating them."

Colleagues described Otto Miller as a rugged individualist, a diplomat, a risk taker, a tough taskmaster, a brilliant intellect. Personable and athletic-looking, Otto Miller also showed bulldog determination, always fortified by mastery of the facts of any issue under consideration. He had little or no patience for mediocre performance. He often worked a six-day week, sometimes staying with the job sixteen hours a day. Since his early days at Chevron, he was described as knowing only one speed when it came to work: full throttle.

Under Otto Miller's tenure as a chief executive, Chevron's income and sales more than doubled, and the company's worldwide crude oil production soared almost two-fold. Also under his direction, the company consolidated its position as an industry leader in developing oil and natural gas in the outer continental shelf of the U.S., expanded direct operations into Europe for the first time, and became one of the world's leading operators of supertankers.

The San Francisco resident and native of Harlan, Iowa, was educated at Iowa State College and the University of Michigan, where he received a Ph.D. in chemical engineering in 1934. He joined Chevron after graduation, and spent his early years in research and development at the company's El Segundo, California, refinery. While there, he became one of the early authorities on catalytic cracking and directed a successful technical research program that led to the construction of the company's first hydrogen sulfide plant, which made an early contribution to environmental air quality.

At the outset of World War II, Otto Miller was counsel to the government's aviation gasoline program. In 1940 he moved to San Francisco where he began his extraordinary rise through the company's manufacturing organization. In 1943 he moved to New York to serve as chief process engineer for the Arabian American Oil Company, a Chevron affiliate, and was chiefly responsible for the planning and construction of the Ras Tanura refinery in Saudi Arabia. This refinery, which produced 100,000 barrels per day of aviation gasoline, made a significant contribution to the ultimate success of the allies in Europe and Asia.

At this point in his career, Otto Miller had demonstrated a conscientiousness in improving manufacturing techniques and in finding more productive uses for personnel and equipment. His remarkable capabilities and inexhaustible dedication were quickly recognized and rewarded.

In 1944 he returned to the west coast to serve as assistant to the general manager of the manufacturing department and superintendent of the cracking division at El Segundo. In 1946 at the age of thirty-seven, Otto Miller became the youngest man ever to hold the position of general manager of Chevron's Manufacturing Department.

In 1954 Otto Miller was elected a vice-president of the company, with responsibility for manufacturing operations on the west coast. During this period, he developed an engineering concept that resulted in the construction of a pipeline from the Rangley Field in Wyoming to Salt Lake City. Under his general guidance, a new refinery was designed and constructed at Salt Lake City and refined products were transported by pipeline to the west coast.

In 1957 he was assigned new and broadening responsibilities—natural gas utilization, crude pricing, and east coast marketing activities. In 1959 he was elected to the board of directors and assumed responsibility for eastern hemisphere operations. Two years later, in 1961, Otto Miller was named Chevron's eighth president.

One of his primary tasks was to integrate the recently acquired Standard Oil Company (Kentucky) into then-Standard of California's corporate family. For a number of years afterward, that purchase was a vital refining and marketing part of the company in the southeastern United States. By now, however, Chevron bore little resemblance to the company that had hired Otto Miller twenty-seven years earlier. What had been essentially a west coast company concentrating in a rapidly growing area had become an international complex with far-flung interests and wide diversifications.

On December 29, 1966, Otto Miller became the company's chief executive officer and chairman of the board of directors. He wasted no time in putting his imprint on the company. He foresaw accelerating demand for petroleum energy throughout the world and the company's need to sustain its momentum of expansion and growth. Within months plans were executed to expand the company's majority-owned and-operated refinery at Pernis, The Netherlands. Later, an entirely new refining facility was erected at Feluy in Belgium.

The company also participated in the construction of a new refinery in The Bahamas—a facility primarily to manufacture fuel oil for the northeastern U.S. As clean air laws were enacted and other sources of energy were restricted in their use, demand for petroleum products soared. Chevron responded by redoubling its efforts to locate new sources of oil, often in remote areas of the world.

In order to effect greater economies and safety in the worldwide transportation of crude oil, Otto Miller launched the company on a ten-year marine expansion program, which more than tripled the capacity of the company's international tanker fleet. Terminal facilities were enlarged or adapted to accommodate the new generation of ships.

During Otto Miller's tenure as chief executive, Chevron extended its role as an innovator of petroleum processes. New hydro-cracking and reforming methods were developed and patented by the company and incorporated into refinery expansion projects. Otto Miller also was strongly conscious of the company's marketing image. He directed the revitalization of corporate identity, which included new service station architecture, a remodeling and rebuilding program for existing units, and a redesigned Chevron hallmark.

Otto Miller knew the true meaning of involvement and participation. His contributions to Chevron and the entire petroleum industry are manifold and well known. In addition to being active in numerous petroleum-and transportation-related councils and associations, Otto Miller served two consecutive one-year terms as chairman of the board of directors of the American Petroleum Institute, the industry's principal trade association.

During that time, he spoke forcefully on the need for the petroleum industry to communicate with the public on issues of vital concern, especially on the environment. He urged both government and industry to work together to create reasonable solutions to pollution problems by relying heavily on technological advancements. He had also been a member of the National Petroleum Council and the Business Council.

As a director on several company boards and an active leader in civic and trade groups, Otto Miller also was a well-rounded, full-time citizen, dedicated to America and to his family. On the occasion of a commencement address at the University of Southern California (USC), Otto Miller received an honorary doctor of laws degree. The chairman of USC's board of trustees, in presenting Otto Miller for the degree, stated: "Otto Miller has earned the hearty respect of his peers, and he has served in numerous esteemed professional positions. He has earned the respect of his community and nation for invaluable civic and philanthropic efforts. And he holds the respect of the world for service on many significant international commissions. Above Standard Oil's familiar double Chevron is an invisible but unmistakable arc—the Otto Miller brand of success."

Otto Miller served on the company boards of Crocker National Corporation, The Weyerhaeuser Company, and Equitable Life Assurance Society. He was also a director of the California State Chamber of Commerce, National Center for Voluntary Action, the San Francisco Opera Association, and the United Nations Association of the United States of America. He was chairman of the United Nations' twenty-fifth anniversary observance in 1970.

In addition, Otto Miller served on the board of trustees of the National Review Board of The East-West Center, and the council of the Americas and Grace Cathedral. He was also a member of the board of governors of the San Francisco Symphony Association, the Business Committee for the Arts, the management council for Bay Area Employment Opportunity, and the advisory council of the Stanford Graduate School of Business.

In 1980 an Otto N. Miller professorship in earth sciences was created at Stanford University. He received a distinguished achievement citation from his undergraduate alma mater, Iowa State University, in 1982, and in 1983 was awarded the Anson Marston Medal at Iowa State. Earlier, he was honored with a distinguished alumnus citation from the University of Michigan, as well as a number of other recognitions from the University of Michigan and Iowa State University.

Despite his strong dedication to hard work, Otto Miller never lost his passion for "hard play" in the rugged out-of-doors, which began with his boyhood on a farm in Iowa. In retirement, he was afforded the luxury of channeling his massive energies into these pursuits. He especially enjoyed bird hunting and trout fishing. Throughout his career Otto Miller had a rich family life, and spent much of retirement time enjoying the companionship of his wife, son, daughter, daughter-in-law, three sisters, one brother, and five grandchildren.

Philip McCord Morse

1903-1985

By Robert Herman

Philip McCord Morse, professor emeritus of physics at the Massachusetts Institute of Technology (MIT), founder and pioneer of modern operations research, physicist and renaissance scientist, community leader, and leader in professional societies, died on September 5, 1985, in Concord, Massachusetts. As Phil Morse wrote in his autobiography, *In at the Beginnings: A Physicist's Life,* 1977, "They told me I was born on August 6, 1903, at three in the morning; I don't remember. My seventy-year memory tape is a series of vividly recollected scenes, separated by blanks later filled in with conjecture and hearsay. The early scenes are disconnected flashes, glimpses of a now unfamiliar world, seen through a stranger's eyes. It takes effort to remember how different that world was, how many differences there are between the Midwest of 1910 and the East Coast of the 1970s."

Morse's distinguished career in science and technology is characterized by a remarkable breadth and diversity of interests. In physics, it ranged from acoustics and quantum mechanics to nuclear physics and methods of theoretical physics. In operations research, which he pioneered, his career encompassed military operations research, vehicular traffic, queues, and public systems. His fundamental contributions in these diverse areas, together with his service to the pro fessional community and society in general, created a most outstanding career.

His early development years were spent in Cleveland, Ohio. He was the son of a telephone engineer, the grandson of a civil engineer, and the great grandson of an architect and builder. His great grandfather worked for the federal government designing and building post offices and custom houses all over the country and was also elected to the Ohio legislature. While still in grade school, Morse read voraciously, was attracted to chemistry, and learned to play the violin. He indicated that while facts didn't interest him very much he was excited by patterns, such as the recurrent patterns in the Mendeleev table of the elements. During high school he decided to become a chemist. Interestingly, he never aspired to be a mathematician because, he said, mathematics had been treated as a tool rather than as a subject for intellectual exploration. Eric Bell's *Men of Mathematics* had not yet been written when Morse made that statement; he later speculated that if the book had already appeared he might have become enmeshed in the mysteries of prime numbers of Diophantine analysis and his entire life might have been different. As for his nonscholastic interests, when the radio craze hit Cleveland in the early twenties, Morse operated his own radio supply and repair shop.

After one year of undergraduate study, Morse took the year 1922-23 off to operate his radio business when family fortunes were at a low ebb. By the fall of 1923 when he returned to college as a sophomore, he was considerably more certain about what he wished to learn. Upon deciding to pursue the physics program, his father's only comment was, "That's fine, but what will you do for money?" It is interesting to read in Morse's recollections that he didn't share this concern for money and that he envisioned a career teaching college physics. He commented at the time that "Professors never got rich—but then they never seemed to starve."

Morse received his B.S. in 1926 from what was then the Case School of Applied Science. He pursued his graduate studies at Princeton University and received his Ph.D. in physics in 1929. It was during his undergraduate days that he became involved with the eminent American physicist Dayton C. Miller, who was one of the earliest experts in sound and musical acoustics, and whose large collection of flutes is now in the Library of Congress. It was during this period that Morse developed his lifelong interest in acoustics.

Physics and mathematics claimed much of his time as a graduate student at Princeton. Three courses didn't sound like much to him, but analytic dynamics, electron theory, and mathematical physics generated a great work load. Unlike the students of pure mathematics, Morse was interested in analysis and higher algebra as the language of physics. The late 1920s were exciting times thanks to the development of the new quantum mechanics; in 1930 Dirac prophesied accurately that quantum mechanics would explain all of chemistry and most of physics.

Aside from his course work and research on molecular physics with Ernst Stueckelberg, with whom he published several papers, Morse developed a solution for a force that was repulsive when two particles are close together, attractive when they are further apart, and under which they vanish at greater distances. He realized that he had stumbled upon a quantum mechanical representation of a vibrating diatomic molecule. To this day, the particular force field, expressed as a related potential field, is known as the Morse Potential.

Edward Condon, upon his return from Europe, where the new quantum theory had been developed, decided to write an English text on the subject. When the writing progressed too slowly, he invited Morse to collaborate. The idea appealed to Morse as an opportunity to learn the rapidly developing quantum mechanics not only by teaching it but by structuring a monograph on it. Thus, Morse coauthored one of the earliest texts on the new quantum theory.

Among his other notable associations, he assisted in the development of the theoretical understanding of the Davison-Germer experiment during a summer at the AT&T Bell Laboratories. His postdoctoral studies were conducted with Arnold Sommerfeld in Munich and included theoretical research in electron scattering under an international fellowship. Thanks to Morse's early renown, Karl T. Compton, then president of MIT, asked Morse to join the MIT physics faculty when he returned from his fellowship in Europe. As Morse recounts—"It was easy to say yes."

So Morse joined the MIT physics faculty in 1931 as assistant professor, rapidly rose to associate professor in 1934, and became a full professor in 1938. With his very broadly gauged interests, he participated in the development of the physics curriculum and accepted the position of graduate registration officer. His research continued in a diverse fashion; during this period he worked on electron scattering, nuclear binding forces, and even on the subject of stellar interiors in astrophysics. One of his important contributions to physics was the acoustics textbook *Vibrations and Sound* published in 1936. This work presented the application of scattering theory to sound waves. In fact it was also during this early period in Morse's life that he developed course notes that were later combined with those of Herman Feshbach to produce the famous two-volume work *Methods of Theoretical Physics,* published in 1953. The book is a basic source of methods of mathematical physics to this day.

With the advent of World War II, Philip Morse's renaissance talent entered a new phase in his technical life. By the time the United States entered the war, the catastrophic loss of allied ships to the German U-boats in the Atlantic Ocean was a major concern. It was imperative that the U.S. develop superior equipment that would locate and neutralize this threat. The British, who had been engaged in the struggle for two years, already had several operations research groups not only designing equipment but also studying and maximizing its effectiveness in actual war operations.

Early in 1942 the U.S. armed forces established an operations research group in the navy. Morse, who was considered a distinguished scientist and who had been the director of a project at the Underwater Sound Laboratory at Harvard University for the previous two years, was chosen by the National Defense Research Council to head the operations research effort.

Several months after the formation of the operations research group, the navy consolidated the antisubmarine operations under the Tenth Fleet, and the Antisubmarine Warfare Operations Research Group was transferred to Washington, D.C. Morse had a substantial fraction of the group out in the field working with the operational commands. He did an outstanding job both in coordinating the technical work and in his liaison with the operational leaders running the actual war operations. Those who worked with Morse during this period report that it was a continuous learning experience. As the war effort and operations research became more successful, the Antisubmarine Warfare Operations Research Group became the navy's Operations Research Group. This group took on submarine activity studies in the Pacific Theater of Operations. It then addressed naval air activities and ultimately became involved in all aspects of navy task force operations. The group became very well accepted and at the conclusion of the war Morse received the Presidential Medal for Merit, the nation's highest civilian award.

After the war Morse generated an orderly windup of the group's activities, part of which became the nucleus of the Operations Evaluation Group. He returned to research and teaching at MIT but continued to monitor this postwar transition. In 1946, he had been at MIT no longer than one year when he became the director of the Atomic Energy Commission's Brookhaven National Laboratory. The position occupied all of his time in organization and administration and left no time for personal scientific research. In 1948, with Brookhaven well established, Morse went to Washing ton to organize an operations research group for the Secretary of Defense and the Joint Chiefs of Staff. This resulted in the Weapons Systems Evaluation Group for which he served as deputy director and director of research until 1950. The group's civilian unit developed into the Institute for Defense Analyses in 1956; Morse served as a trustee.

In another area of interest, Morse was convinced of the great importance of computation and the rapidly growing power of the digital computer. This no doubt arose from his experience with calculations in acoustics and astrophysics in the late 1930s. The establishment of the MIT Computation Center was a result of his efforts to introduce computers to research and research to computers in the late 1940s and early 1950s. He became its first director and served in that position until 1967.

In 1952 Morse created an operations research activity at MIT with an interdepartmental committee and a small contract for fundamental research from the U.S. Army. In two years, the first doctoral student, John D. C. Little, was graduated, and in 1956 the Operations Research Center was formally established with Morse as director; he remained in this role until his official retirement in 1968. His high research activity in the field of operations research was continuous and included the following books: *Queues, Inventories and Maintenance,* 1958; *Library Effectiveness: A Systems Approach,* 1968; *Operations Research for Public Systems,* 1967, coeditor; and *Analysis of Public Systems,* 1972, coeditor.

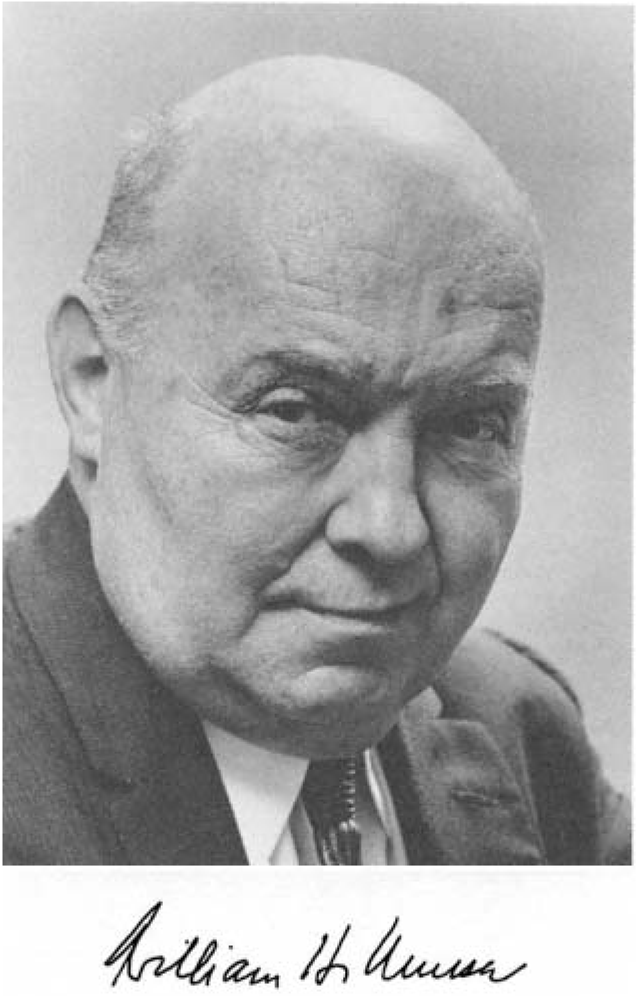
The Operations Research Society of America (ORSA) was founded in 1952, and as might have been expected, Morse became its first president. Of the next eight presidents, half had worked for him in one capacity or another, mostly during World War II. About twenty years later, there came an echo of Morse's influence as two of his former students became presidents of the society. Morse received the Frederick W. Lanchester Prize of the Operations Research Society in 1968 for his library work and was the first recipient of that society's George E. Kimball Medal in 1974 for his contributions to the profession of operations research in general and to the Society in particular.

Professor Morse's worldwide promotion of operations research never ceased. He was involved in organizing the first International Operations Research Conference in 1957; the International Federation of Operations Research Societies originated at this conference. Interest in the operations research discipline overseas led to the 1959 North American Treaty Organization conference with Morse as chairman of the advisory panel. He was associated with many international operations research projects in which he always stressed that the discipline was applicable to a host of fundamental problems that were neither military nor industrial in nature. It is interesting to recall that most recently, in April 1985, at the age of 81, Morse chaired a session at ORSA's Boston meeting and spoke on the early use of computers in operations research, a topic that combined two of his major interests.

Morse's honors are legion. Among these, he was a member of the National Academy of Sciences; and a fellow of the American Academy of Arts and Sciences, the Acoustical Society of America, and the American Physical Society. He was elected to the National Academy of Engineering in 1985. He was also a member of Sigma Xi, Tau Beta Pi, and the Cosmos Club of Washington. He received the Silver Medal of the Operational Research Society of the United Kingdom, and the Gold Medal of the Acoustical Society of America. He was the president of the Acoustical Society of America (1950-1951) and of the American Physical Society (1971-1972). In addition, he was a member (1974-1977) and chairman (1975) of the Governing Board of the American Institute of Physics. From 1958 to 1960 he was chairman of the MIT faculty.

Philip Morse, one of the first wave of home-grown American scientists, made outstanding contributions to science and technology through his work in physics, computer science, and operations research. He influenced and guided many students and colleagues in the struggle to seek scientific truth. In his autobiography Morse gives great food for thought to many of us. He reflects that his successes would have been fewer had he not chosen, back in 1923, to become a physicist through training that forced him to look facts in the face, that made him want to measure them and work out their implications, whether these facts applied to atoms or automobiles.

The last comment of Morse's autobiography conveys much of his philosophy—"For those who like exploration, immersion in scientific research is not dehumanizing; in fact, it is a lot of fun. And, in the end, if one is willing to grasp the opportunities, it can enable one to contribute something to human welfare."



William Henry Mueser

1900-1985

By Richard H. Tatlow III and
Anton Tedesko

William H. Mueser, a world-renowned civil engineer and partner of Mueser Rutledge Consulting Engineers, was born in New York City April 10, 1900, and died in Charlottesville, Virginia, on June 25, 1985. He was elected a member of the National Academy of Engineering in 1978. Mr. Mueser was a constructionman's engineer, always ready to roll up his sleeves and go to work. He was as comfortable making technical decisions on complicated design problems as he was plunging into a construction problem in the field. He used the science of engineering as a tool to supplement his own practical experience covering more than fifty years in the heavy construction field. In addition to knowledge and experience, he was that rare individual who brought creative imagination and versatility to bear on each problem. These qualities, combined with total dedication to his profession, resulted in outstanding contributions over the years to the art and science of foundation engineering.

Bill Mueser came from a family of engineers. His father was a pioneer in reinforced concrete construction in the 1890s and the early part of this century, his specialty being the design of concrete bridges throughout the country. Bill was raised in New York City and spent his career there. He attended DeWitt Clinton High School and the Massachusetts Institute of Technology (MIT), obtaining his B.S. in civil engineering in 1922. Bill did graduate work at the Technische Hochschule in Berlin, Germany, in 1922 and 1923. His devotion to MIT continued from his first association. He was vice-president of his class from graduation until his retirement and for many years his service included interviewing candidates for admission to the Institute. On the completion of his engineering studies in October 1923, he joined the staff of Moran, Maurice & Proctor, predecessor firm to Mueser Rutledge Consulting Engineers. His first assignment was the deep foundation construction for the Barclay-Vesey Building of the New York Telephone Company. This was followed by many deep foundations in lower Manhattan, such as for the Chase Manhattan Bank headquarters, the addition to the New York Stock Exchange at 20 Broad Street, and land construction for the $1.1 billion Battery Park City complex of office and apartment buildings. He pioneered in replacing the expensive compressed air caissons with deep open foundations for major buildings and bridges throughout the United States. Examples are Nos. 1, 2, and 99 Wall Street.

Bill Mueser became a partner in the firm in 1936, handling major projects for the firm until his retirement in 1975 after fifty-two years of service. At the start of World War II he was the partner assigned to represent the firm in the Drydock Engineers, a combination of four firms assembled to carry cut the design of major graving docks for the U.S. Navy's Bureau of Yards and Docks. He was involved in the design and construction of many drydocks, including the one at Bremerton, Washington, which was the world's deepest and largest in volume of ship space. This dock has a length of 1,152 feet, a width of 188 feet, and a depth of 53 feet below high tide.

He was a partner in Pardo Proctor, Freeman & Mueser, Caracas, Venezuela, from 1944 to 1951.

Deep foundations for bridges were a major part of his firm's work during Bill's long association and leadership.

Some of the interesting jobs were the specially designed pneumatic caissons for the San Francisco Bay Bridge (240 feet deep); the Huey P. Long Bridge in New Orleans; the Bronx-Whitestone in New York City; the Tacoma Narrows Bridge in Washington; and the Rapids Bridge, Quebec, Canada. His later work included bridge foundations for the Delaware River Crossing of the Pennsylvania Turnpike, as well as bridges and earthwork designs for sections of the Indiana Toll Road and Delaware Interstate Highway.

Bill was the author of a great many engineering reports on foundation and soil problems as they related to construction projects. All were carefully and uniquely thought out, and each added to his outstanding reputation.

Bill Mueser was particularly proud of his work on a number of public projects. Among these were the underpinning of the East Front of the Capitol Building in Washington, D.C., the firm's participation as general soils consultant for the Washington Metro subway, foundation design for the United Nations Secretariat and General Assembly Buildings in New York City, and the Empire State Plaza in Albany, New York.

He was a registered Professional Engineer in seventeen states and active in the New York Planning Board. He was also a member of The Moles, American Arbitration Association Panel, American Concrete Institute, American Institute of Consulting Engineers (past vice-president, council), American Road Builders Association, American Society of Testing Materials, Boston Society of Civil Engineers, Concrete Industry Board, Engineers' Joint Council (past member Engineering Manpower Commission), Society of American Military Engineers, U.S. National Council on Soil Mechanics & Foundation Engineering, and New York Building Congress (governor). He received the Metropolitan Section's "Engineer of the Year" Award in 1958 and the Moles' Member Award in 1975. He was also named an honorary member of the American Society of Civil Engineers, that society's highest honor.

Bill Mueser was married on April 21, 1925, to the late

Edna M. Meyer and they lived in Bedford Village, New York, where they enjoyed a happy and busy life. They were active in church work and always contributed to worthy causes. They had four children: Caryl Adele, William Henry, Robert Ranson, and Gayle Evelyn (Mrs. Arthur Schulman). Bill, Jr. and Robert are engineers, following their own careers in construction.

Morrough Parker O'Brien

1902-1988

By Richard G. Folsom and

Robert L. Wiegel

Morrough Parker O'Brien, dean emeritus of the College of Engineering, University of California, Berkeley, an engineering educator of renown, founder of modern coastal engineering, and consultant on a wide variety of vital engineering projects, died July 28, 1988, at his home in Cuernavaca, Mexico, at age eighty-five. He is survived by his wife, Mary, of Cuernavaca; a son, Morrough, of Boulder, Colorado; and a daughter, Sheila, of Berkeley, California.

> Mike, as he was known to close acquaintances, was a dynamic and powerful person. He enjoyed tackling problems and getting things done through hard work. He did not shrink from making decisions, and once made, he did his best to implement them. He was conscientious and always thoughtful in his approach, but persevering. His interests were broad and his knowledge pervasive. One of his most important characteristics was always looking ahead trying to foresee what was to occur. (University of California: *In Memoriam,* 1988, Academic Senate.)

He foresaw the coming changes in engineering from a largely descriptive approach to an analytical basis and proceeded to guide the Berkeley and national education programs in this direction. He was also alert to the importance and difficulties of effective technology transfer from research to practical application. Many of his ideas, and details on how he implemented them, are given in the 312-page printed version of his oral history, *Morrough P. O'Brien: Dean of the College of Engineering, Pioneer in Coastal Engineering and Consultant to General Electric, An Oral History Conducted 1986-88 by Marilyn Ziebarth,* Regional Oral History Office, The Bancroft Library, University of California at Berkeley, 1988.

Mike was born September 21, 1902, in Hammond, Indiana. He completed high school in Toledo, Ohio, and after some starting college studies entered the Massachusetts Institute of Technology at Cambridge, Massachusetts, receiving his B.S. in civil engineering in 1925. After two years of graduate work at Purdue University, he was the John R. Freeman Scholar of the American Society of Civil Engineers for study of fluid mechanic subjects in Germany and Sweden. Throughout his career he kept on the "cutting edge" of engineering and science by extensive self-study.

Mike always combined his considerable faculties for teaching, research, and professional engineering for mutual enhancement of achievements. His academic base was the College of Engineering at the University of California, Berkeley, from his appointment as assistant professor of mechanical engineering in 1928 to his recognition at retirement in 1959 as the dean emeritus of the College of Engineering. He received his professorship in 1936, serving as chairman of mechanical engineering from 1937 to 1943, followed by sixteen years as dean of the college. During his years at Berkeley, the national ratings of excellence for the college increased from good to outstanding. This was recognized by the Regents in awarding him the LL.D. in 1959 and by the Academic Senate in 1988 with the Clark Kerr Award, made to "An individual considered to have made an extraordinary and distinguished contribution to the advancement of higher education." This award was presented to Mike by Clark Kerr, president emeritus of the University of California. Of his many special assignments within the University, we consider his dynamic leadership as Academic Senate chairman during the faculty loyalty oath controversy and as institutional representative for the University Engineering, Science, Management War Training Program from 1941 through 1944 to be good examples. He was a most capable, yet demanding and interesting, classroom teacher as well as the author or coauthor of over a hundred published articles including many on technical subjects and engineering education, and coauthor of *Applied Fluid Mechanics,* published by McGraw Hill in 1937 (one of the first three texts to present the then new methods of treating flow problems). The building on the Berkeley campus that houses the Hydraulic Engineering Laboratory and the Water Resources Center Archives is named O'Brien Hall in his honor.

While in Berkeley, Mike completed, in a consulting capacity, many engineering assignments in a wide range of applications, such as pump selection and performance testing, fluid meters standards, propulsion systems for amphibious tanks (FMC Corporation), regulation of the estuary of the Columbia River, and sand bypassing at the Santa Barbara Harbor, California (probably the first such application as the solution to a common problem and now in general use). With the U.S. Navy Bureau of Ships, he was concerned about underwater sound and propeller noise, as well as torpedo design with General Electric Company. He also participated at Bikini (1946) in "Operation Crossroads." On leave from the University as director of research and development for more than a year for the Air Reduction Company (Airco), he worked with a wide variety of engineering technical and management problems, establishing the research and development activities of that company.

Mike was executive engineer of the Radiation Laboratory under Professor Ernest O. Lawrence in 1942-43. O'Brien was asked by Lawrence and General Groves, the Manhattan Project director, to recruit an engineering team to design the production facilities at Oak Ridge for the electromagnetic system. He has said that probably the most important thing he did in his life was to convince them that there was not time to build a competent staff, and that they should hire companies with an established engineering staff to do the job.

O'Brien was the founder of modern coastal engineering. He wrote a number of papers that have had a lasting influence and encouraged others to work successfully in solving coastal problems. He was appointed civil engineer for the U.S. Army Board on Sand Movement and Beach Erosion in 1929, and initiated this board's research on coastal engineering by personally conducting field studies on the New Jersey and Long Island shores. In 1930 he made field studies along the coasts of Washington, Oregon, and California and wrote a detailed seven-volume report on the results of his observations. A landmark paper on the relationship between tidal prisms and entrance areas of natural estuaries was one of the results of these studies. He summarized many of his early observations in his paper "The Coast of California as a Beach Erosion Laboratory" *(Shore & Beach,* July 1936). His work on sand bypassing was mentioned above. His work in using graphical means of estimating wave refraction was done a few years later. In 1938 he was appointed a member of the Beach Erosion Board, U.S. Army Corps of Engineers, and served on it until is was abolished in 1963. He was then appointed to its successor, the Coastal Engineering Research Board, serving from 1963 until 1978, a total of forty years on the two boards.

During World War II, he worked for the U.S. Navy Bureau of Ships on subjects described above, and he directed a program of field and laboratory studies of landing craft. With Professor H. U. Sverdrup of the Scripps Institute of Oceanography, he also worked on the forecasting of waves. Examples of his work are given below. The use of dimensionless parameters relating wind speed, fetch, and wave height and period were thought of by Mike at that time, and he recommended their use in a memorandum to Sverdrup and Walter H. Munk; they are still in use today. Around 1950 Mike conceived of the equation containing both viscous and inertial terms expressing forces exerted by waves on pile-supported coastal and offshore structures. The equation, developed by one of his graduate students (J. R. Morison) through extensive laboratory tests and by others at the University through field tests, has been used in the analysis of wave loading of nearly every coastal and offshore structure using piles, columns, and/or tubular bracings.

Mike and Professor Joe W. Johnson started what are now known as the International Conferences on Coastal Engineering. The first was held in Long Beach, California, in 1950; the most recent, the twenty-first, was held in Torremolinos, Spain, in 1988, with Mike still active in choosing the more than 250 papers presented at the conference. He served as president of the American Shore and Beach Preservation Association from 1972 through 1983.

After his retirement from the University, Mike made many visits to the University of Florida during an interval of twenty-one years; he was very interested in the coastal processes along the extensive Florida coastline. His close colleague there, Professor Robert G. Dean, commented on Mike's continued love for visiting and observing beaches and raising questions during such a trip that would provide research topics for several graduate students. During these exchanges with the students, he would "range out" beyond the limits previously identified; provide the benefits of his experience and background on related problems; and infuse the students with enthusiasm, motivation, and direction. He continued this activity through his last visit in 1988.

About 1950 Mike began his longtime consulting on technical and management problems with the General Electric Company, where he was still active at his death. Although he was associated with other divisions, his most significant work was with the Aerospace and Defense Group where the compressor design for the first American axial-flow jet engine was laid out exactly in accordance with the method presented in the paper by O'Brien and Folsom entitled *The Design of Propeller Pumps and Fans.* He was elected to the General Electric Company Propulsion Hall of Fame in 1984.

Mike received three honorary degrees: D.Sc., Northwestern University; D.Eng., Purdue University; and LL.D., University of California. He was an honorary member and fellow of the American Society of Civil Engineers and the American Society of Mechanical Engineers, and elected to honorary membership in the American Society for Engineering Education in 1969 (awarded the Lamme Award in 1968) and the Japan Society of Civil Engineers in 1988. He was elected to membership in the National Academy of Engineering in 1969. (Note: In 1956 Mike suggested to the president of the Engineers' Joint Council, Enoch Needles, that a national academy of engineering might be a good idea. *The Making of the NAE: The First 25 Years,* by Lee Edson, National Academy Press, 1989). Mike was a member of the National Research Council's Committee on Engineering Implications of Changes in Relative Mean Sea Level (1984-1987); the Army Scientific Advisory Panel from 1954 to 1965, serving as its chairman from 1961 to 1965; the Defense Science Board from 1961 to 1965; and the Board of the National Science Foundation (a presidential appointment) from 1958 to 1960. For his service to the U.S. government, he was twice awarded the Distinguished Civilian Service Medal by the Secretary of the Army.

William S. Pellini

1917-1987

By William J. Harris, Jr.

William S. Pellini, a major contributor to the science and practice of metallurgical engineering and component design, died February 25, 1987, of a heart attack at age sixty-nine. He was known to his friends, colleagues, and professional associates as one of the most astute and competent investigators of complex phenomena in the fields of materials and service performance. During his long and distinguished career, he made significant contributions to the design of highly stressed steel structures, to the design and inspection of nuclear containment vessels, to the failure analysis of railroad equipment, to the development of programs for research on methods of controlling aerodynamic heating, and to many other fields.

Mr. Pellini was raised in a family that emigrated to the United States from Italy. His forbearers came from a small community in Northern Italy that was known throughout the world for their skill in design and construction of stone structures. Members of the community would take commissions from Russia, Central Europe, England, or elsewhere that might require them to be away from home for two or three years engaged in stone cutting and the erection of magnificent personal or public buildings.

He had an early interest in metallurgy and entered Carnegie Mellon University in the depths of the depression. He completed his work and received his initial degree in 1940, but continued work at the University until 1942, when he was commissioned in the United States Navy. From 1942 to 1946, he served at the Naval Proving Ground, Dahlgren, which was a center of research and study related to light and heavy armor and projectiles. The work done at the Armor and Projectiles Laboratory at the Naval Proving Ground, Dahlgren, vastly improved the capability of both naval ships and naval aircraft to operate and survive in the combat environment. He made critically important contributions to the heat treatment of steel during his service with the navy and became deeply interested in the problems of materials fracture at high strain rates.

In 1947 he joined the Oak Ridge National Laboratory, but left there in 1948 to join the Naval Research Laboratory (NRL). At NRL, he became head of both the casting and the welding divisions. He made singular contributions to the flow of metal in castings and to the processes of welding.

In his work on welding, he not only contributed to the technology of welding itself but also used weldments as a basis for comparing the fracture resistance of different kinds of steel. He applied explosive techniques that he had learned at the Naval Proving Ground, Dahlgren, to achieve rapid deformation of a plate made up of two different kinds of steel joined by a brittle weldment. Under identical explosive loading conditions, brittle cracks moved rapidly into the two different plates. This made it possible to learn much about brittle fracture and materials selection to control brittle fracture. His contributions came at the time that George Irwin and others were studying fracture. The combination of Pellini's applied metallurgical approach and Irwin's more fundamental physics approach led to the establishment of the science and engineering of fracture mechanics. Mr. Pellini was one of the pioneers in this field, with his work started in 1949 on the explosion bulge tests.

Mr. Pellini became superintendent of the Metallurgy Di vision at the Naval Research Laboratory in 1954 and led a group of dedicated individuals in work on the Navy Nuclear Submarine Program and the Naval Ship Program. They examined the relationships between design requirements, material selection, and fabrication. They studied the effect of nuclear radiation on fracture properties. In his career, he demonstrated that brittle fracture occurs when there is an error in design, fabrication, or materials selection. A brittle material can survive if there are no flaws in fabrication and if the design prevents dynamic loading. His genius in failure analysis and his ability to extract the right inferences from complex design and fabrication issues were legendary.

In 1958 Mr. Pellini took leave from the Naval Research Laboratory to join the staff of the National Research Council of the National Academy of Sciences and its Materials Advisory Board. He served as staff director of a major project on reentry materials that grew out of the 1956 and 1957 von Kármán studies on long-range planning for air force research and development. The program was directed at designing a long-range program of research on materials to cope with aerodynamic heating. Mr. Pellini assembled a distinguished group of preliminary designers and thermo-dynamicists to establish the thermal environment in missions ranging from reentry of intercontinental ballistic missiles, to vehicles returning from moon missions and vehicles engaged in extended supersonic operations in the atmosphere. He assembled the data on the thermodynamic environment and established a relationship between that environment and properties of the promising materials and designs. He was able to present this information in a single chart that elegantly portrayed the most promising avenues of research for addressing the aerodynamic heating problem. The work done by Mr. Pellini was used as a guide for many years in directing work on ablative materials, on cooling systems, and on radiating materials such as the tiles currently used in the space shuttle.

He continued his studies at the National Research Coun cil as staff director on a project to address space power requirements. With the help of preliminary design advisers, he was able to establish an array of requirements, taking into account weight, power requirements, and duration of mission. On that array, he was able to overlay the capability of a wide variety of systems to provide space power and demonstrate the most promising directions of research for satisfying the emerging missions. His work made a significant contribution to research in this field.

In 1958 he returned to the Naval Research Laboratory, resuming his position as superintendent of the Metallurgy Division and serving temporarily as an associate director of the Naval Research Laboratory. In the Metallurgy Division, he continued to supervise important work on materials and their behavior until he retired in 1974.

Upon retirement, he joined the Association of American Railroads as a senior consultant, working on problems of brittle fracture. While there, he completed textbooks on the reliability and safety of structural steels and narrated videotape short courses defining sound approaches to design and materials selection.

During his study of tank car failures, he began to examine opportunities for new materials in tank car designs. This led him to an exploration of work being done on micro-alloyed steels with lower carbon contents than were current in American practice. He established the value of these lower carbon, high-strength steels, with their high weldability and very good impact properties. Through a series of studies and demonstrations, he won support for application of these materials to new tank cars. The current standards in the industry require these materials. His pioneering work on fracture problems and solutions contributed in a significant way to the reduction in service failures in the railroad industry.

Those who worked under his direct supervision and who were privileged to be his associates benefitted greatly from his scholarly assessment of materials, their behavior, and their performance. His work on nuclear containment vessels, ship structures, railroad components, and the broad issue of design to accommodate fracture made a major contribution to the entire field of materials design and engineering.

He received many honors in the course of his long professional career. The Washington Academy of Sciences recognized his work in 1954 and awarded him an Outstanding Achievement Certificate. The U.S. Navy awarded him the Distinguished Civilian Service Award in 1961. His brilliant work on the flow of metals in castings was recognized by his receipt of the John A. Penton Gold Medal of the American Foundrymen's Society in 1961. His continuing work on submarine hulls, nuclear vessel containment, and related naval problems earned him the Gold Medal Award of the American Society of Naval Engineers in 1962. He was awarded the U.S. Department of Defense Distinguished Civilian Service Award in 1963. His contributions to the development and application of the field of fracture mechanics won him the Albert Sauveur Achievement Award of the American Society for Metals in 1972, and the U.S. Navy's Robert Dexter Conrad Award for scientific achievement in 1973. He was a fellow of the American Society for Materials International.

He was elected to the National Academy of Engineering in 1974.

Mr. Pellini was a brilliant student, hard working, self-effacing, competent, and capable of moving to new fields and accommodating to their requirements, while achieving his objectives.

Those of us who had the pleasure of his company over the several decades of his professional life are grateful for his contributions to engineering. We continue to miss him.

At the time of his death, survivors included his wife, Katheryn Hatch Pellini, who has since died; two daughters, Linda Pellini-Dunn of Carver and Carolyn Ross of Waldorf, Maryland; one son, Carl Pellini of Oxnard, California; and seven grandchildren.

Robert L. Pigford

1917-1988

By Arthur B. Metzner

Robert L. Pigford died on August 4, 1988, after suffering a stroke on May 14. His strength had previously been severely sapped by a heart attack in June 1987, but he had worked diligently to revitalize his physical vigor after that event and he continued to serve his university with enthusiasm as a senior colleague, a trustee, and our preeminent scholar.

Robert Pigford was born and raised in Meridian, Mississippi. He received a B.S. degree in chemical engineering from Mississippi State College in 1938 and his M.S. and Ph.D. degrees from the University of Illinois in 1940 and 1942, respectively. Robert and Marian Pigford moved to Delaware in 1941 when he accepted employment with the DuPont Company, and very shortly thereafter he began his association with the University of Delaware on a part-time basis, teaching evening and weekend courses. His department continues to receive regular requests to this day—nearly half a century later—for copies of his long out-of-print textbook, *The Application of Differential Equations to Chemical Engineering Problems,* which was based on his early lectures at our university and coauthored with another DuPont colleague W. R. Marshall.

In 1947 Allan Colburn, noting that Robert Pigford was spending increasing portions of his evening and weekend hours on campus, invited him to come to the university during weekday daylight periods as well. The invitation was an offer to appoint him, at age thirty, chairman of the Department of Chemical Engineering. Robert Pigford consulted his industrial colleagues about the wisdom of such a move; their response was to advise him to make a listing of the objective advantages of each career alternative. Of course, they were confident that a continuing productive career with the nation's leading chemical company would appear much more attractive than the alternative of work in a fledgling department in an underdeveloped university with no Ph.D. programs and with few resources. And just as they had anticipated, when the listing was made, all of the objective advantages were with the industrial option. But, of course, there were also nonquantifiable subjective attractions to the university career: forging a new department and, indeed, assisting in the development of an entire university; working with succeeding classes of young scholars and assisting in the emerging renaissance of his profession; and getting the opportunity in Robert Pigford's words "to have fun professionally."

We all know what his choice was, but this story was the basis of his frequent advice to students and to younger colleagues in subsequent years: "*always* choose the professional alternative which you would find to be the most enjoyable. It is only by making this choice that you will throw yourself into your work with sufficient enthusiasm and vigor to become an accomplished professional and, as a by-product, a serene and supportive spouse and parent."

What fun it was for all of us who were to be associated with him! We learned to laugh together as well as to work together, and to live together. Marian and Robert Pigford opened their hearts as well as their home to our families, and we benefitted unashamedly from their devotion to this, their family of scholars. If any of us, who were long-term friends of the Pigfords, developed some altruistic qualities, it would have been due in large measure to their inspired example.

Robert Pigford did not enjoy the many administrative chores his position implied, but he dealt with them forthrightly.

Several of his colleagues remember his unique manner of seeking advice on major administrative issues. All faculty offices, in those long ago days in Brown Laboratory, were along one corridor: the chairman's at one end and the most recently appointed assistant professor at the other. Robert Pigford simply gathered any papers necessary for a discussion of the issue in one hand and, with a pad and pencil in the other, proceeded to interview each faculty colleague in turn. When he came to the end of the hallway, perhaps no more than thirty minutes later, he had all the information he needed for an informed decision—and none of his colleagues were diverted from their activities for more than a few minutes each. How nostalgically one looks back upon such a straightforward procedure in these days of excessive committee responsibilities! Once, when this procedure was described to a faculty friend from another department, the latter queried "How could you be sure he would accept your advice?" We who were his friends were speechless: this was simply an unthinkable occurrence in the Pigford department. *Of course* he would accept advice if he requested it; his generosity of spirit was such that chthonian machinations between him and his colleagues were simply unthinkable. His colleagues, in turn, were usually equally ready to grant him discretion in use of any advice he sought. Such indeed was the Pigford department: one administered by mutual altruism. And his vision for his university was that all departments would some day practice such altruism. Can there be a more beautiful vision?

Professionally, his department developed rapidly under his leadership to become one of the outstanding departments nationally. He was one of the earliest proponents of the use of computers in engineering and built several for both instruction and research before the widespread availability of such equipment. He was instrumental in establishing the computer center for the University of Delaware community and in the establishment of a graduate program in metallurgy and materials science.

Robert Pigford's advice was sought by numerous indus trial, academic, and governmental institutions. He was deeply interested in, and concerned by, the ethical dimensions of science and technology and served much time on national committees devoted to clean air standards and to the safe disposal of nuclear wastes. In addition, from 1983 until his death Robert Pigford served as the gubernatorially appointed faculty representative on his university's board of trustees.

Robert Pigford received almost all the awards for leadership in research and education of his principal professional society, the American Institute of Chemical Engineers. On the occasion of its seventy-fifth anniversary, he was named as one of thirty foremost leaders of the chemical engineering profession. He was elected to the National Academy of Engineering in 1971 and the National Academy of Sciences in 1972—one of only a small number of scholars nationally to achieve this dual distinction. The university has recognized this distinction by bestowing on him the unique title of university professor in 1975 and by naming him as its first Alison scholar in 1977. In 1988 he was named Delaware's Engineer of the Year by the Delaware Society of Professional Engineers.

Robert Pigford was the founding editor of the journal *Industrial and Engineering Chemistry Fundamentals,* an activity to which he devoted a full quarter century. In 1965 he left Delaware to serve as a professor at the University of California, Berkeley; he returned ten years later.

To sum up, Robert Pigford lived the life of a most distinguished scholar and most unselfish, magnanimous leader, whose love for his university was so deep that he really lived for the day when all of it might function as serenely and effectively as his own department did when he was its chairman. To the extent that we who are here today achieve this, we are building the memorial to him he would wish to have. His unselfishness is perhaps best summed up in the words of the late Robert Perry, one of his earliest students: "A Prince among Men." We miss him.

Milton Pikarsky

1924-1989

By Anton Tedesko

Milton Pikarsky was born March 28, 1924, in New York City and he died on June 15, 1989, of a heart attack in Washington, D.C., on one of his countless trips to participate in professional meetings. His home was in Yonkers, New York, his office at the City University of New York (CUNY). Most of his adult life was spent in Chicago, where his name is identified with some of the outstanding achievements in public works and transportation.

Pikarsky was a talented, experienced, productive, hardworking civil engineer, a most dedicated public servant; he provided leadership in public positions of trust and responsibility. An expert in substance as well as in procedure, he had the initiative, the opportunity, and the authority to get things done. The challenge of his job, the opportunity to serve, inspired and drove him to excellence. He viewed his work as a service to the region and to the people of that region. He found his reward in that knowledge.

His parents were immigrants from Moldavia, now one of the Soviet socialist republics. They settled in New York City and led a rather frugal life, working hard in their candy store, later in their hat shop; they made sacrifices so that their children would have what they lacked: a good education. Milton was influenced and impressed by his mother. She and his family experience, public schools, and the City College of New York shaped his thinking and values. He was committed to the need for education and research to enable engineers to make contributions to the community, which he believed were their professional responsibility. He was used to making a serious study of whatever engaged his active mind. He served as personal or professional mentor to many of those with whom he came in contact.

Pikarsky graduated from City College in 1944 with a degree in civil engineering and went to work for the New York Central Railroad. With World War II still going on, he soon took a leave of absence to serve in the U.S. Navy. Following military service, he spent ten years with the railroad as assistant engineer in Chicago; during some of that time he was in charge of the reconstruction of the LaSalle Street Station. In 1956 he became a partner in the firm of Plumb, Tuckett & Pikarsky, specializing in the design and construction of highway and railroad bridges.

In 1960 he began his official relationship with the city of Chicago, which would soon make him a key figure in Chicago's public works history. The administration of Mayor Richard J. Daley was a critical period of growth and change for the city. The challenge of building and rebuilding required people of engineering and administrative talents, and the Mayor attracted and recruited a nationally respected professional staff. He had first noticed Pikarsky's ability when Pikarsky was an enthusiastic member of the team designing and building the east end of the Congress Expressway underneath the Main Post Office and the LaSalle Street Station. Pikarsky brought his unbelievable optimism, energy, and dedication to this challenging project.

At the age of thirty-six, Pikarsky was picked by Daley to be the engineer of public works for the city of Chicago, and was regarded as one of the mayor's most competent and trusted cabinet members. Four years later, at age forty, he was picked to serve as Chicago's youngest commissioner of public works. During his tenure, he supervised more than $1 billion in public works construction, including the expansion of O'Hare Airport, the construction of the Water Purification Plant, the building of the Adlai Stevenson Expressway, the extension of rapid transit lines, and the construction of many sewers and bridges. His Northwest Incinerator was an early example of a waste-to-energy facility. The Sears Tower, the world's tallest building, might have been two smaller buildings if it had not been for Pikarsky's critical role and intervention in arranging for all the technical clearances needed to assure this tower's feasibility.

Pikarsky was elected Chicago's Engineer of the Year; at times he was the focus of critical attention of the public and the media. Numerous times he was on the verge of being "fired" when he insisted on doing what he thought was the right thing professionally, and not what local politicians demanded. The mayor was on his side and backed him in the face of political pressure. But, at times the mayor hid behind Pikarsky or conveniently made him the scapegoat when the mayor had difficulties with members of his own party.

On occasion, Pikarsky experienced great disappointment when his plans fell victim to party politics. He had proudly assembled a talented interdisciplinary team of engineers, architects, and planners that came up with many innovative features for the design of the Crosstown Expressway; this road was to allow traffic on the interstate to bypass downtown Chicago. The project became a political football, and was cancelled when a candidate for the election of governor demanded that the project be killed. The only portion saved was what is now known as the Kennedy Expressway with its extension to O'Hare airport.

It was during this period that Pikarsky earned an M.S. in civil engineering at the Illinois Institute of Technology (IIT), where years later he became a faculty member.

In 1973 Pikarsky was elected to the National Academy of Engineering (NAE), and he was confirmed as chairman of the Chicago Transit Authority. As Mayor Daley's chief transportation expert, Pikarsky's reputation and influence were felt on the national scene. He was a tireless advocate of federal support for urban transit and worked with the staffs of congressmen in Washington on changes in public works legislation. He was instrumental in moving legislation towards enactment for equitable treatment of persons displaced by federally assisted programs. It was a high point of satisfaction for Pikarsky when President Nixon signed the bill that provided a ten-fold increase in the capital funding for transit. Pikarsky had conceived, drafted, and worked in Washington on this and other bills that were strongly supported by the Illinois congressional representatives mobilized by Pikarsky.

Pikarsky was active and held offices in many organizations, such as the American Public Works Association (APWA), and the National League of Cities and its Steering Committee on Transportation. He substituted for Richard Daley at the U.S. Conference of Mayors, was chairman of committees on urban transportation goals and objectives, and on mass transportation; he was president of the Western Society of Engineers, and chairman of its Transportation Division.

His approach to transit was regional and bipartisan. He played a major role on a task force set up by the Republican governor, which in 1975 led to the formation of the Regional Transportation Authority (RTA). After political infighting, Pikarsky was selected as its first chairman. The RTA had jurisdiction over four counties (Republican and Democratic); it operated like a government and had taxing authority. Pikarsky thus became the czar of the regional commuter railroads, the rapid transit system, and the city's and suburban bus lines. A regional gasoline tax was designed to discourage commuters from driving to work.

Milton Pikarsky was married in 1947 to Sally Nessel; they had two children, Amy and Joel. Milton's habit of working fourteen to sixteen hours every day was not conducive to a balanced family life. Sally came down with a long, serious illness and was confined to a hospital where Milton visited her daily until her full recovery. In 1975 by amicable agreement, Milton and Sally parted. Milton moved to an apartment where his commuting time between home and office was reduced to a few minutes. After years of a life filled with professional work, he came rather late to the realization that it was also necessary for him to have a personal life—and the children to whom he was devoted became one of his priorities.

More and more Milton became involved in transportation research and he lectured regularly on transportation subjects at the University of Illinois and at the Illinois Institute of Technology. In 1978 he resigned from the RTA in view of the political changes that had taken place in Chicago. He joined the Research Institute of IIT and devoted a considerable amount of time to bring his public works experience to bear on the curriculum. The graduate program he developed received official recognition.

In his 1977 seminars at the Chicago Campus of the University of Illinois, he was assigned a bright, young graduate assistant, Christine Johnson from Laramie, Wyoming, who was finishing her Ph.D. in planning. Milton became her adviser, mentor, and colleague. They were married in 1978, and for the eleven years until his death, they were each other's best friend.

On assignment from the World Bank, Pikarsky reviewed transportation structures in the Buenos Aires metropolitan area. He became a member of an international team serving the economic minister of Argentina. Similar assignments involved entering the planning process and expanding public transit systems in the United States and Canada. Pikarsky participated in international conferences and transportation assignments in European countries, as well as in Australia.

On a two-week transportation tour of the Soviet Union, arranged by the U.S. Department of Transportation, he covered numerous republics and cities; on his own he roamed the Moscow subway, where he took dozens of photos of small children and then presented each of these smiling and wide-eyed children with the Polaroid picture just taken—a dramatic novelty. This was characteristic of his compassion and warm human qualities.

Pikarsky was busy in Washington, as a member of the National Research Council's (NRC) Transportation Research Board (TRB) from 1974 to 1978, and as a member of the TRB Executive Committee from 1982 to 1989; he served as chairman of the TRB from 1975 to 1976. He chaired the Committee for NRC Oversight for seven years, ensuring that TRB's activities conformed to NRC standards and guidelines. Pikarsky's dedication and energies through many years with TRB were recognized by the W. N. Carey, Jr. Distinguished Service Award (1988).

Here are several of his many other honors: the Urban Administration Award of IIT (1968); the Townsend Harris Medal of the City College of New York (1969); the James Laurie Prize (1977) and the Civil Government Award (1973), both from the American Society of Civil Engineers of which Pikarsky was a fellow; and the Meritorious Service Award of the APWA (1984). He was declared one of the Ten Top Public Works Leaders of the Year by the APWA (1969).

Pikarsky was active in an unbelievably large number of professional, academic, industrial, and civic organizations. Within a dozen years, he held office in twenty organizations including chairmanship of six subcommittees of NRC. He was chairman of NRC's Bay Area Rapid Transit (BART) Impact Program Advisory Committee and a member of its Committee on Public Engineering Policy; and a member of NAE's Awards Committee and of its Civil Engineering Peer Committee. Pikarsky kept up with friends at city, county, state, and federal levels. He wrote or coauthored sixty-seven articles and two professional books; his papers were on technical subjects and on questions of policy.

At IIT in Chicago, he pursued efforts to coordinate transportation research activities of several universities. He planned, with several other universities, to establish an Institute of Transportation Systems (ITS) at IIT; his entrepre neurial flair helped him to convince people that his plans should be executed. However, IIT was not in a position financially to start any new ventures, so Pikarsky looked elsewhere for the realization of his dreams.

The key figures in Chicago public works considered Milton Pikarsky their leader, a colleague, a friend, a mentor, and a member of their family. But first and foremost, they considered him a builder. When asked about the secret of success, Pikarsky replied that while ability certainly helps, what really counts are persistence, willingness to take risks, and good luck. He added that his secret of being lucky was to give oneself enough chances to be lucky by trying things and taking risks. Sometimes the result might be exposure to situations that might not be pleasant, but at other times the result might be "good luck".

All along Pikarsky felt indebted to the City College of New York for having given him an excellent education, tuition-free; he felt, therefore, an obligation to give of himself to the new generation studying at what is now the City University of New York. This institution that gave him his start in life asked him in 1985 to return as a distinguished professor of civil engineering, and to set up a transportation research institute. He believed he owed it to the institution; so he came back to his alma mater, leaving Chicago and friends after more than forty years, and moved to New York where he was relatively unknown. He bought a house in Yonkers and his wife, Christine, became director of Transportation Planning for the Port Authority of New York and New Jersey.

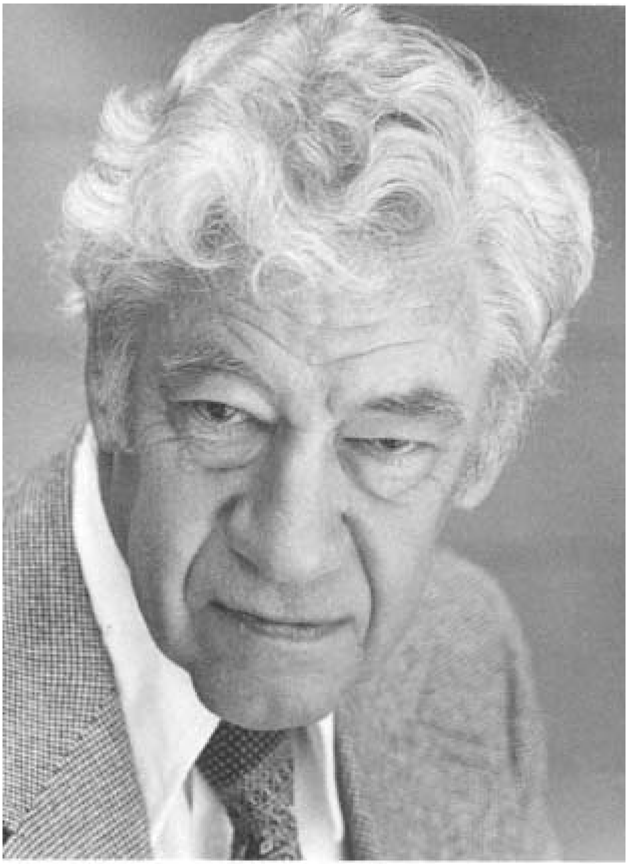
Milton enjoyed making repairs around the house and on the car. They both worked late in their offices and had hurried dinners on weekdays after returning home together; on Sundays Milton enjoyed cooking dinners or taking trips in their trailer camper.

At CUNY, Pikarsky helped establish and became the head of the Institute of Transportation Systems; he organized and became the executive director of a Transportation Re search Consortium, in which twelve universities of the eastern United States (including Columbia, Cornell, and Princeton) jointly conducted research, training, and technology transfer. At the same time, he filled what may be called another full-time job as director of Engineering Studies for the National Council of Public Works Improvement, a Washington assignment commissioned by the President and by the Congress. Pikarsky inspired staff members to strive for excellence; during this evaluation, he counseled and supported them through difficulty. He selflessly gave guidance and advice on the condition of public works in the United States, resulting in recommendations to the President and to the Congress. At the same time, on yet another full-time assignment, he served as a consultant on problems nationwide, was a consultant to the commissioner of Transportation of New York State, and kept up his active membership on numerous committees engaged in a variety of engineering causes.

Milton Pikarsky was a kind, compassionate, and caring person, personally modest, an optimist with vision and faith, integrity, and tenacity. He felt obligated to help people and enjoyed doing so. He took young people under his wing. It never occurred to him that some might not like what he was doing; when people opposed him, he never doubted their good intentions or motives.

Pikarsky became a civic statesman, using quiet determined efforts; he loved challenges and thrived on difficult assignments. He saw public service as the highest calling. Looking back at his professional life, it could be said that he had the mind of an imaginative technocrat and the heart of an idealist.

He is survived by his wife Christine Johnson, who has been appointed assistant commissioner of transportation for New Jersey, and his children Amy (in Los Angeles) and Joel (in Ft. Collins, Colorado).



W. Duncan Rannie

1914-1988

By William R. Sears

Duncan Rannie was born in Canada, the son of the beloved physician of a small Ontario town. He was educated in the fine British-Canadian tradition and graduated from the University of Toronto in 1937 with an M.S. in applied mathematics. He was attracted to the California Institute of Technology by the fame of Theodore von Kármán and the institute's other bright stars, and continued graduate studies in mathematics there in 1938. When he observed that the kind of mathematical applications that interested him most was found in the applied science departments at Cal Tech, he became a candidate in aeronautics.

He was a brilliant student. Von Kármán became involved with the Tacoma Narrows Bridge disaster and the aerodynamics of suspension bridges in general; he made Rannie his trusted assistant in theoretical and experimental (wind tunnel) studies in this area, and Rannie produced definitive studies and reports on bridge dynamics and flutter.

He was also a key player when von Kármán and several of us, his students, became interested in power generation by wind power—the project that led to the Smith-Putnam Wind Turbine, which was constructed on Grandpa's Knob in Vermont. Unfortunately, Rannie's analytical findings regarding the stability of the giant windmill were not incor porated in the prototype that was built and tested on the mountain.

The relationship between von Kármán and Rannie was warm. In 1942, following von Kármán's suggestion, Rannie joined the staff of Northrop Aircraft, where a major project was under way to produce an aircraft gas turbine—the "Turbodyne" project—sponsored by the U.S. Navy. There, during the war years, Rannie developed theories and design procedures for axial compressors. This was pioneering work, based on sound theoretical principles, that became the basis for much of the progress of gas turbine technology that followed.

In 1945 Rannie returned to Cal Tech, specifically to the Jet Propulsion Laboratory (JPL), where he continued his studies of flow in axial compressors and turbines. He was encouraged to write up his definitive work on suspension bridges to complete the Ph.D. program that had been interrupted by wartime work, but he preferred to write on heat transfer in turbulent flow; this dissertation was accepted and published; his Cal Tech doctorate is dated 1951. He became chief of Ramjet and Combustion Research at JPL in 1945. In 1951 he moved from JPL to the main campus as an associate professor and a major member of the Daniel and Florence Guggenheim Jet Propulsion Center. He continued both theoretical research and publishing in gas turbine technology, and served his adopted nation on the Air Force Scientific Board, the first and second Air Force Long-Range Planning Groups, the U.S. Air Force's Aircraft Propulsion Laboratory Advisory Panel, and industrial advisory committees. His students became leaders of the aircraft engine industry throughout the western world.

Duncan Rannie was elected fellow of both the American Rocket Society and the American Institute of Aeronautics and Astronautics, and in 1979 was elected to the National Academy of Engineering. He became Goddard Professor of Jet Propulsion at Cal Tech, and in 1956, director of the Daniel and Florence Guggenheim Center.

He was a devoted family man and, throughout his life, a lover of nature. His personality was one of great modesty—he considered his own research and publications to be quite unexceptional. He was deeply devoted to his students and to the profession of teaching. His dour sense of humor was worthy of his Scottish-Canadian forbears—and the delight of his host of friends and admirers.

Stephen O. Rice

1907-1986

By David Slepian

Stephen O. "Steve" Rice, a communications engineer of worldwide renown and a pioneer in the applications of probability techniques to engineering problems, died of pulmonary fibrosis on November 18, 1986, at the Scripps Memorial Hospital in La Jolla, California. He was seventy-eight. During the previous fourteen years, he had served on the staff of the University of California, San Diego, as a research physicist in electrical engineering and computer sciences. He will be missed by the engineering community for his special talents and his scientific contributions; he will be sorely missed by those who knew and loved him for the fine man he was.

Steve Rice was born on November 29, 1907, in the small town of Shedds, Oregon, the only child of Stephen Rice, a buttermaker, and Selma R. Bergren. Some years later the family moved to Astoria, Oregon, where Steve finished his secondary education. Subsequently, he entered Oregon State University, Corvallis, and there received a B.S. in electrical engineering in 1929. It was during his senior year that he met Inez Biersdorf, who two years later became his wife and lifelong companion.

The academic year 1929-30 was spent in Pasadena, California, where Steve undertook graduate studies in physics at the California Institute of Technology. In the fall of 1930, he joined Bell Telephone Laboratories, then located in New York City in lower Manhattan. For the next forty-one years until his retirement in 1972, Bell was to remain Steve's technical home and the center of his professional activities. His first job there was with a small group of mathematically inclined engineers involved in transmission research. The mathematical analysis of communication systems became and remained his primary technical interest.

During his long career with Bell Laboratories, Rice's official title, his department, and his location of work changed several times, but the nature of his work remained much the same. His great talent was recognized very early, and Steve was soon given a free hand to pursue research of his own interest. These interests, inspired by the problems he saw about him, fortunately overlapped closely those of the Laboratories, and so a fruitful and lasting partnership was made. As Steve's contributions became known and as his reputation grew, he was actively sought out as a consultant by many different groups within the Laboratories. In this role, he was invaluable. At the time of his retirement from Bell, Steve's title was "Head, Communication Theory Department" and his work location was Murray Hill, New Jersey. In this role he oversaw a small group of top theorists and pursued his own research.

Rice had two periods of leave from Bell. In the depths of the depression, he returned for a year to the California Institute of Technology where he undertook further graduate studies while working on the Bateman Manuscript Project. This group prepared the first modern comprehensive series of volumes on the integral transforms and transcendental special functions of applied mathematics. Rice's deep knowledge of the classical special functions shows up in many of his later research papers. He was indeed a master of the classical analytic techniques their use demands. His second leave came much later when he served in 1958 as a Gordon McKay visiting lecturer at Harvard University.

Rice published sixty-three scientific papers during his career.

With a few exceptions they fall into five categories: electromagnetic theory, applied mathematics, communication devices and systems, traffic theory, and noise theory. His work greatly influenced each of these fields. His contributions were always original and deep; many were seminal. His 1950 paper "Communication in the Presence of Noise" was the first in the new field of Information Theory to evaluate explicitly bounds on the error probability attainable with ideal systems. It preceded by ten years a burst of similar activity that occupied the information theorists in the 1960s. His 1951 paper "Reflection of Electromagnetic Waves from Slightly Rough Surfaces" was fundamental to the understanding of radar return from the ocean and celestial bodies. It was an early application to two dimensions of his methods in applied stochastic processes. The famous 1963 paper "Noise in FM Receivers" with its ingenious original definition and analysis of "clicks" solved the long mystery of the sudden deterioration of FM above a certain threshold of noise and gave the most profound treatment of that modulation method.

One could cite other contributions of similar unusual merit, but it is for the monumental paper "Mathematical Analysis of Random Noise," published in two parts in the *Bell System Technical Journal,* Vol. 23, July 1944, pp. 282-332, and Vol. 24, January 1945, pp. 46-156, that Steve will be best remembered. This long paper, really a treatise, laid the foundations of noise theory and at the same time solved many of its most interesting, important, and difficult problems. The paper has been of utmost importance in communication theory, ocean engineering, material engineering, aircraft design and analysis, and many other fields of technology where random phenomena play a significant role. That today, forty-six years later, this work is cited fifty times or more a year in papers from a dozen different fields is testimony to its enduring contribution.

The genesis of this famous paper merits comment. In the early 1940s Rice and many other Bell Laboratories engineers pursued graduate studies at Columbia University on a part-time basis. Many ultimately received their doctorates in this program. Rice did not. He completed his course work and submitted a highly original thesis, the result of many years of work and interest in applied probability. According to an oft-repeated story, which I have not been able to verify, the thesis was submitted to two different departments. Each rejected it, claiming that it was not in their purview. Be that as it may, for whatever reason the thesis was not accepted, and Steve gave up the goal of higher degrees. The submitted work was, of course, the paper "Mathematical Analysis of Random Noise." Years later, for his role in founding the new field that grew from this rejected thesis, he received an honorary D.Sc. from his alma mater Oregon State University.

In his forty years of active work after the appearance of "Mathematical Analysis of Random Noise," Steve published many additional papers that extended the theory and applied it to diverse situations of engineering interest. Almost always in these researches he was motivated by a concrete physical problem, and the mathematics he developed were incidental to the goal of solving the physical problem. Not content with results that were left as formulas, he would always evaluate complicated expressions and present curves and numerical results to illustrate the physical problem. Often these evaluations called for the invention of special techniques of approximation or of numerical analysis, and these Steve published as separate contributions to the mathematics literature. Highly skilled in mathematics and appreciative of the needs of rigor, yet motivated by real world problems and blessed with great originality and physical insight, Steve Rice was the ideal theoretical engineer.

After his retirement from Bell in 1972, Steve and his wife moved to La Jolla, California, where he joined the staff of the University of California with the title research physicist in electrical engineering and computer sciences. He had no official duties there but could be found daily in his office from 7 a.m. until noon pursuing his researches and giving freely of his time to students and faculty alike. Afternoons were spent with his family. He continued his researches actively up to the time of his death.

Steve received a number of awards in recognition of his technical achievements. He was a fellow of the Institute of Electrical and Electronics Engineers and received its M. J. Kelly Award in 1965 and their Alexander Graham Bell Award in 1983. As already noted, he was honored with a D.Sc from Oregon State in 1961. He received the National Telecommunications Conference Outstanding Contribution Award in 1974. His election to the National Academy of Engineering was in 1977.

Great as were his technical achievements, to those of us who worked with him throughout the years Steve made an even greater contribution. He showed us how fine and how noble the nature of man can be. Steve was soft-spoken, quiet in his ways—a somewhat private person, yet with the greatest charity to all. He gave unstintingly of his time to all who asked. His patience seemed endless. He was the most genuinely modest person I have ever known. He seemed totally unaware of his very considerable accomplishments and talents. He coveted neither authority, fame, nor power. His life was his work, his family, and the demonstration of kindness to all.

Steve is survived by his wife, Inez; a son, Stephen E. Rice of Del Mar, California; two daughters, Carole Hanau of Cardiff-by-the-Sea, California, and Joan McHugh of San Diego, California; nine grandchildren and two great-grandchildren. By these and by all who knew him well, this kind and talented man will be forever missed.

Joe B. Rosenbaum

1912-1987

By Milton E. Wadsworth

Joe B. Rosenbaum, a long-term pioneer in the nation's metallurgical industry and a key figure in the industrial development of the domestic uranium industry, died of cancer September 12, 1987, at the age of seventy-five. During the previous thirteen years, Joe Rosenbaum had been an active consulting engineer in the metallurgical industry, in addition to serving both as an adjunct professor for the Department of Metallurgical Engineering and as a member of the Advisory Council of the College of Mines and Minerals Industries for the University of Utah, Salt Lake City, Utah.

Joe Rosenbaum was born March 1, 1912, in Denver, Colorado, the second of four children of Zelich and Rachel Greenblatt Rosenbaum. Joe was the first of their children to be born in America. He developed a hunger for reading at an early age. Because his elementary school had so few books, he would play "hooky" from school and go to the public library to read. His interest in engineering and technical matters was already being established. He attended Manual Training High School in Denver where he excelled in math and science and participated in football, track, and boxing. He graduated from high school in 1929.

In the fall of 1929 he enrolled at the Colorado School of Mines with a scholarship and an ambition to become a metallurgist. In 1932 he had to leave school for a year to work before returning to finish his degree in metallurgical engineering in 1934 during the depths of the depression.

Several months after graduating, Joe obtained a job with the Public Works Administration in Denver. Although the job was engineering, it was hardly metallurgy. A major compensation, however, was that Greta Fredrickson also worked in the office. Over the course of about eighteen months, they fell in love and were married on New Year's Eve in 1935.

In 1937 Joe decided he'd stayed away from the mineral business long enough. He began the operation of a mica mine in the hills west of Denver using a converted 1920 LaSalle limousine to haul ore. He soon tired of this noneconomic operation and obtained a job as a flotation helper for the Walker Mining Company at Walkermine, California, now a ghost town about fifty miles from Reno. By the time he left Walkermine in 1941, Joe had worked his way up through ball mill operator and shift boss to company metallurgist. He had finally achieved stature in his chosen field of metallurgy; he never again left the field, though for a few years his role was more administrative than technical.

His next stop was Boulder City, Nevada, where he joined the U.S. Bureau of Mines as a junior metallurgist. His tenure in Boulder City, however, was interrupted by the war. He entered the Army Corps of Engineers as a first lieutenant in May 1942 and in 1943 was sent to serve in the South Pacific. In 1946 he was released from active duty with the rank of major, and resumed his research career in Boulder City. There he worked on a variety of projects, the most important of which was the processing of manganese ore and winning of chromium from domestic, low-grade ores.

In 1952 he was transferred to the Salt Lake City Metallurgy Research Center where he remained for ten very productive years. The work he directed in uranium and vana dium extraction from complex ores earned him international recognition. He developed successful procedures for both acid and alkaline leaching of uranium and subsequent purification techniques that were incorporated in uranium processing plants. This did much to produce a uniform uranium product from widely dissimilar ores. His well-known papers on solvent extraction of uranium were published during this time. In addition he contributed to the literature in beryllium, rhenium, and thorium recovery, and became expert in solvent extraction and several applications of electrometallurgy.

He declined job offers in Washington, D.C. several times before accepting the position as chief metallurgist of the U.S. Bureau of Mines in 1962. In 1963 he was given the dual assignment of director of metallurgy research and acting assistant director of mineral research. He held the latter position while a permanent director was sought, and was commended by members of congress for the lucid and soft-spoken answers given while presenting the two separate budgets for the three successive years 1963-1965. His leadership in welding four dissimilar research groups, of different disciplines and with different objectives, into an integrated group and other similar accomplishments was well recognized. Although he enjoyed many aspects of this position, he found that he preferred to be closer to actual research. When the position became vacant in 1967, he was appointed research director of the Salt Lake City Metallurgy Center and stepped down in Washington, D.C.

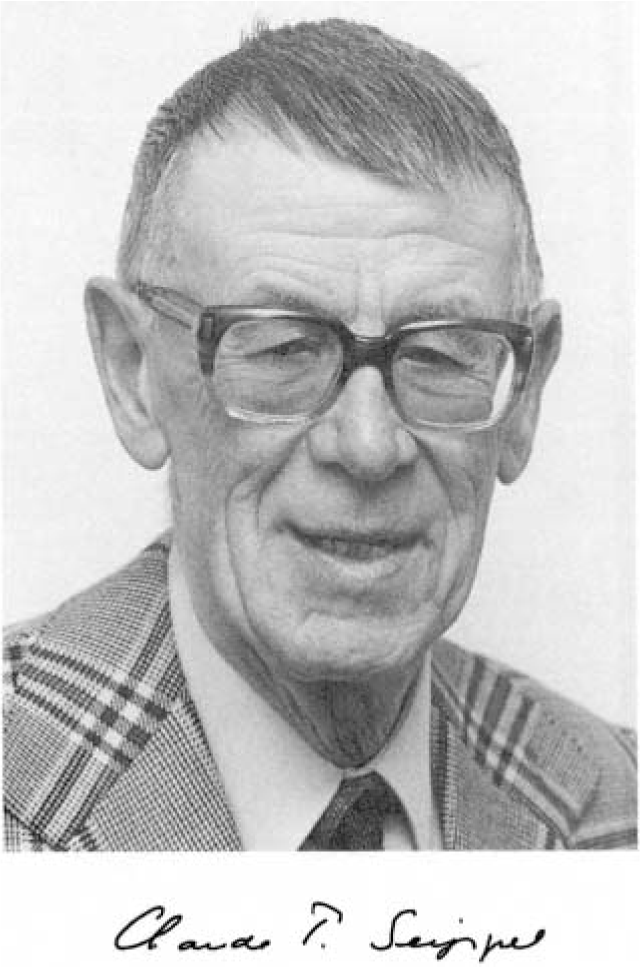
His excellent organizational and leadership skills enabled him to administer his duties as research director while permitting him time to get involved with the technical details of several projects until his retirement in 1974. By 1970 he had developed impressive skills in such areas as ion exchange processing of gold and uranium and extractive processing of titanium and aluminum. During this period, he also worked on sulfur recovery from smelter stack gases.

Joe Rosenbaum received many honors during his career.

Until his death, he was adjunct professor of metallurgy and member of the College of Mines and Mineral Industries Advisory Council at the University of Utah. He was elected a fellow of the American Association for the Advancement of Science, a distinguished member of the Society of Mining Engineers, a member of the American Society for Metals, and a member of the National Academy of Engineering. His many awards include the Distinguished Achievement Award from the Colorado School of Mines, a Presidential Citation for Efficiency in Research Management, the Distinguished Service Award from the U.S. Department of the Interior, and the James Douglas Gold Medal for distinguished achievement in nonferrous metallurgy from the American Institute of Mining, Metallurgical and Petroleum Engineers (AIME). He was a Henry Krumb Lecturer for AIME, and authored or coauthored over sixty publications.

Joe and Greta had three children—Karen, Richard, and John. Karen is a teacher of English and creative writing at Ohlone College in Fremont, California. Richard is a pediatrician and is the founder of Babymed International in Denver, Colorado. John is a research engineer at Chevron Research and Technology Company in Richmond, California. In addition, Joe and Greta had three granddaughters and three grandsons.

In addition to his imposing technical and administrative skills, Joe was a warm, loving person, and his gentle, but firm, manner endeared him to his friends, family, and coworkers, all of whom miss this hard-working and honest gentleman.



Claude P. Seippel

1900-1986

By Kenneth A. Roe

Claude P. Seippel was a brilliant scientist, engineer, inventor, educator, and leader. His greatest impact on engineering came from his activities in almost every important field of turbomachinery. His inventions led to the granting of thirty-eight major patents, and he wrote some fifty significant publications. He died in Switzerland on August 1, 1986, at age eighty-six.

Claude was born on June 14, 1900, in Zurich, Switzerland. He was graduated from the Swiss Federal Institute of Technology in 1922 with an M.S. in electrical engineering.

He started his distinguished career in 1923, joining Brown Boveri Company (BBC) in Baden, Switzerland. He left the company to spend several years in the United States, and rejoined BBC in 1928. His career with BBC can logically be divided into four periods.

From 1929 to 1940, Claude managed the development, design, and testing of a multistage axial-flow compressor, which he patented. This compressor led to the evolution of the gas turbine and had its first implementation as a charging set for the Velox boiler. His first commercial gas turbine unit was a four-megawatt generator for the city of Neuchatel in Switzerland. In addition to the patent on the axial-flow compressor, Claude received patents covering turbocharging, gas turbine governing, and the pressure wave exchanger. His more significant publications during this period dealt with the Velox steam generator, the axial-flow compressor, and heat flow in the blade foot of a gas turbine.

In the second period of Claude's career, from 1941 to 1954, he continued development work on the gas turbine. But he also was responsible for significant improvements in steam-turbine blading design and in combined cycles. He discovered and announced an important limitation to the second law of thermodynamics; the importance of his discovery was not recognized by the experts until years later when the definition of "exergy" was introduced. His discovery is even more significant today with the current emphasis on energy conservation and environmental protection.

It was during this same period that Claude began working with young students, engineers, and scientists, encouraging them to devote their careers to research. The Swiss Federal Institute of Technology elected him to its board of directors, and Swiss Society of Engineers and Architects—the Swiss equivalent of the American Society of Mechanical Engineers—elected him to its governing Central Committee.

This period was a particularly productive one for Claude. His patent for an exhaust turbocharger in 1942 led to a new market, which became Brown Boveri's most important business. In following years, he received patents for a gas turbine for aeronautical use, a device to rotate the wheels of an airplane before landing, methods for mass production of centrifugal blowers for supercharging of combustion engines, a method for regaining mechanical energy, a steam power plant with a feedwater heating system using extraction steam and exhaust gases, a steam generator with pressure firing, and a governing device for turbomachinery.

It was also a highly productive period for Claude's technical publications. In 1945 he published a paper on the use of the gas turbine as a jet engine for airplanes, an early vision that would later lead to one of aviation's greatest technological advances. But his scientific mind was not so preoccupied that he forgot the young engineers he loved so much; one of his articles published in 1953 detailed what industry wanted and expected from its engineers.

From 1955 to 1965, the third period of Claude's career, was his last decade as an active senior technical executive at Brown Boveri. He concentrated on important projects related primarily to energy, large steam and gas turbines, and nuclear energy. His patents during this period ranged from devices to prevent overpressure to methods for calculating the allowable operating hours of thermal machines, and from improved blading for axial-flow turbines to a method of apparatus for the operation of nuclear reactors.

His output of technical papers during this period was particularly prolific, most of them dealing with gas and steam turbines, but some particularly important ones concerned nuclear power. In 1958 he published *Geometric Flow Through Multi-State Turbines,* a thorough investigation of the performance of turbine blades. His analysis, done in an era when computers were not used for such complex calculations, was a major contribution to improved blading for turbines.

Although Claude retired in 1965 as an active senior executive at Brown Boveri, he continued as a consultant to the company in areas both scientific and managerial. During this fourth period in his career, he also continued both his research (which led to five significant patents in his first eight years of "retirement") and his writing; he wrote on complex subjects, such as the aerodynamic aspects of blading research, and on more basic topics, such as how to solve some of the problems involved in enlarging his beloved Federal Institute of Technology.

That same Institute, which had elected him to its board of trustees in 1947 and elected him vice-chairman of the board in 1957, awarded Claude its honorary "doctor honoris causa" in 1959 for his contributions in the turbomachinery field. In 1965 he was named chairman of the Institute's board, and he served in that capacity for many years.

During his long career, Claude gave unstintingly of his time to organizations that were grateful for his ideas and inspiration. He served for eight years on the steering committee of the Swiss Institute for Nuclear Research, and for fourteen years he was a member of the Swiss National Foundation as the representative of the Federal Institute of Technology. He was active in the Swiss Society of Engineers and Architects and for eight years served on its Central Committee. He even found time for civic activities, serving as a member of the Commerce Court of Kanton Argau for sixteen years.

The American Society of Mechanical Engineers elected Claude an honorary member in 1982, and the author was immensely proud to be the one to nominate him for that honor. He was elected a foreign associate of the National Academy of Engineering in 1984. As a memorial to his achievements, Brown Boveri named its main research center at Daetwill after him. In the years before his death he was considered, in the words of a close associate, the "greatest living technical gray eminence of Switzerland."

The author is proud to have known Claude Seippel for many years, and feels privileged to have spent hours discussing with him his thoughts on gas turbines and Velox boilers.

Dr. Seippel's many contributions to the development of thermal power have earned him a lasting place in the history of technological development. The world is a better place because of his brilliance, foresight, perseverance, and dedication.

J. George Thon

1908-1988

By Edgar J. Garbarini

J. George Thon, designer and constructor of major water, power, tunnel, and transit systems around the world, died on September 6, 1988, at the age of seventy-nine.

Elected to the National Academy of Engineering in April 1975, George was a dedicated professional known for his technical expertise and his willingness to contribute his time and effort to the improvement of engineering practices, both in the companies he worked for and in the larger technical community.

During his career, which stretched over five decades, George worked on more than 20 hydroelectric power plants, 33 dams of many types, 11 pumping plants, and 110 miles of tunnels. More than 8,000 megawatts of hydroelectric generating capacity plus the design and construction of mass transit systems from London to San Francisco were influenced by his design skills and management expertise.

George received his B.S. from the University of Lwow, Poland, in 1932 and his diploma in civil engineering from the Imperial College of Science and Technology, London, in 1939. Two years later he earned his M.S. from the University of London.

By that time, the world was embroiled in the second of its great wars, and George immediately set about contributing to the allies' war effort. As a design engineer with Sir

William Halcrow and Partners Consulting Engineers, Great Britain, he served as a consulting engineer on the Mulberry Artificial Harbor, used for the invasion of France. During his years with Halcrow, he also worked on extensions of the London subway and numerous hydroelectric projects.

In 1949 George moved to an area of the world with large, untapped hydroelectric potential—America's Pacific Northwest. As an hydraulic engineer with Pioneer Service and Engineering Company, he was responsible for the design of hydroelectric projects for the Northern State Power Company and the Umpqua River Development in Oregon.

George joined Bechtel in 1951 as a chief civil engineer of its Power Division. He was in charge of design for thermal electric plants, nuclear power plants, and heavy industrial plants such as Dresden Nuclear Plant, Riddle Nickel Smelter in Oregon, and the Port Everglades Steam Electrical Station. And as a Bechtel supervising structural engineer, he was in charge of civil and structural design of the Pittsburg and Gadsby Steam Electric Plants.

In 1959 George was a project civil engineer on the Morro Bay Steam Electric Plant in California; his technical paper on that project, coauthored with Pacific Gas & Electric's Gordon L. Coltrin, received the distinguished Thomas Fitch Rowland Prize from the American Society of Civil Engineers (ASCE).

In the 1960s George's work expanded beyond U.S. borders when he became the division manager of engineering and vice-president of Overseas Bechtel, Inc. Fluent in German and Polish, George also had a good grasp of Russian and French, which served him well in his new position. He was responsible for engineering hydroelectric projects around the world. Among his notable assignments was membership on the design review committee for the 5,250-megawatt Churchill Fall Hydroelectric Project, which at that time was the largest hydro undertaking in the Western Hemisphere.

During the 1960s George also oversaw the development and construction of several impressive transportation infra structure projects, as governments around the world sought to create and improve facilities. George was responsible for important phases of design on the Bay Area Rapid Transit (BART) system in San Francisco; work on the Washington Metropolitan Area Transit Authority's METRO in the District of Columbia; and transit systems in Caracas, Venezuela, and Sao Paulo, Brazil. He also worked on airports in Hilo and Keahole, Hawaii, and in Amman, Jordan.

George's skills in hydroelectric and transportation projects earned him the respect and admiration of his colleagues. He was known for his extensive experience in the design and construction of rock and soft-ground tunnels and the underground construction of transit stations and hydroelectric power plants.

With a temporary warming of relations between the United States and the Soviet Union in the early 1970s, George with his overseas experience and Russian-speaking abilities was asked to coordinate Bechtel's activities in the Soviet Union. He twice visited the USSR. touring many hydroelectric facilities before further shifting of political tides precluded continued work in that country.

George became an executive consultant and member of the senior technical staff of Bechtel's Hydro & Community Facilities Division in the mid-1970s. As with all his duties, he performed them with skill, dedication, and professionalism.

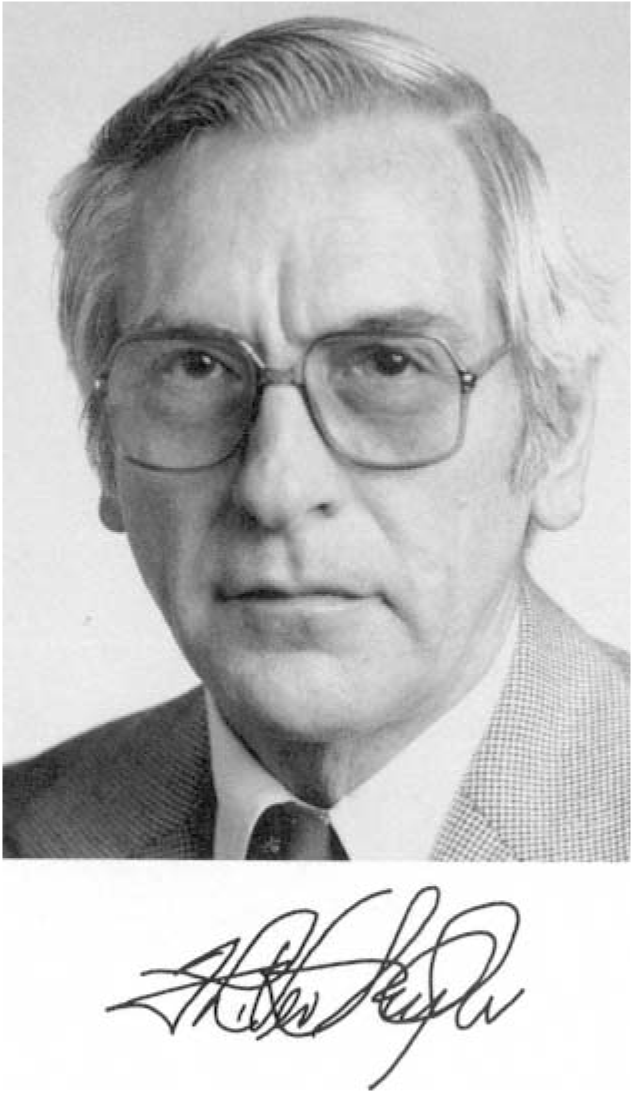
In 1978, after more than forty years of outstanding civil engineering work, George retired, but could not leave the engineering field far behind, occasionally offering his expertise on selected consulting assignments. He was a registered civil or structural engineer in twenty-two states and a chartered civil engineer in Great Britain.

Throughout his professional career, George garnered many awards besides the Fitch Rowland prize. He received the Tercer Lugar Prize in 1964 from the Pan-American Congress of Engineers for his paper on rapid transit systems for major cities. In 1971 ASCE again honored him with the Rickey Medal for a paper on the Salt River Project. C. H. Whalin of the Salt River Project and John O'Hara of Bechtel were his coauthors. He was elected as a fellow in the ASCE in the United States and the Institution of Civil Engineers in the United Kingdom. George also served as a consultant to the National Science Foundation's Division of Advanced Productivity Research and Development.

Of his many publications, George was especially proud of papers he wrote for ASCE, *Water Power, Tunnels & Tunneling,* and the *Journal of the American Water Works Association.*

George was also concerned with the improvement of civil engineering and dedicated considerable time and attention toward that goal. He served on many ASCE committees including its Water Resources Coordinating Committee in the early 1960s, and he twice chaired its Power Division's Executive Committee, in 1964-1965 and again in 1972-1973.

George's dedication and expertise helped not only in the successful design and construction of projects around the world but also in furthering the knowledge base for the entire civil engineering discipline.



Francis Louis VerSnyder

1925-1989

By Maurice E. Shank

Francis L. VerSnyder, retired assistant director of research for materials technology, United Technologies Research Center, and one of the world's most distinguished high-temperature metallurgists, died suddenly November 28, 1989, at the age of sixty-four.

Frank, as he was known by everyone, was born in Utica, New York, May 27, 1925, and grew up in Watertown, New York. His mother died in giving birth to him. Due to the circumstances of his early life, the principal influence in his youth was the parish priest of the local Roman Catholic church. During his high school years and after graduation he worked for the Watertown Highway Department until he was drafted into the United States Army at age eighteen in 1943. After his discharge from the Army in October 1945 he entered Notre Dame University, South Bend, Indiana. He graduated in 1950 with a B.S. in metallurgy. While at Notre Dame he married Katherine Kelly of Watertown.

In 1954 Frank joined the General Electric Company in Lynn, Massachusetts, working on problems of high-temperature metallurgy for early turbojet engines. His last position in Lynn was as supervisor of metallography and high-temperature testing. In 1954 he received the Henry Marion Howe Medal of the American Society for Metals, his first professional recognition, for work performed a year earlier on microconstituents of high-temperature alloys.

In 1955 he transferred to the General Electric Research Laboratory in Schenectady, New York, and remained there until 1961. Believing that his future at the laboratory was limited by his lack of a doctorate, he accepted an offer to become head of alloy and materials development in a newly formed research and development operation at Pratt & Whitney, United Aircraft Corporation (now United, Technologies) in East Hartford, Connecticut.

At Pratt & Whitney, the wide world of opportunity opened for his initiative, technical inventiveness, and ability to innovate by carrying his inventions into production and application. He proceeded to invent the directionally solidified high-temperature airfoil, precision cast, complete with intricate cooling passages, for use in advanced gas turbines. From this flowed the development and application of the mass-produced single-crystal airfoil. He was awarded a pivotal U.S. patent, "Gas Turbine Element," covering this "quantum leap" in the state of the art. The work opened a new field of applied high-temperature metallurgy, with more than one hundred subsequent patents issued to others. Use of these materials provides greater durability and substantial fuel savings in commercial aircraft, and allows higher thrust, increased fuel efficiency, longer life, and greater maneuverability and range in military applications.

The first production application of directionally solidified blades was for the TF30-P100 engine powering the F111 fighter-bomber. During the 1970s every new Pratt & Whitney engine model entering production contained directionally solidified airfoils, including engines that powered the Boeing 747 and Douglas DC-10-40, and the F-100 engine that powered the Air Force F-15 and F-16 fighters. Directionally solidified airfoils are also used, under license, in the space shuttle main engine, and in engines built by General Electric, Garrett Turbine Engine Company, and Rolls Royce. Beginning in 1978 and subsequently, single-crystal turbine airfoils were introduced in both military and commercial engines, including those for the advanced F-15 and F-16, the Boeing 747, 767, and 757, and the Airbus A310.

In recognition of his achievements, Frank was elected to the National Academy of Engineering in 1981. He was a member of many professional societies and was active on committees and boards relating to society organization, awards selection, and professional matters. He served on many National Research Council ad hoc committees and on the Peer Review Committee of the National Bureau of Standards. Frank was the author of forty-seven papers and technical presentations.

In 1965, United Aircraft honored him with the George Mead Gold Medal for Engineering Achievement. Subsequent honors included the Dickson Prize Award and Medal of Carnegie Mellon University in 1972; the Francis J. Clamer Medal and Life Fellowship of the Franklin Institute in 1973; and the College of Engineering Honor Award of the University of Notre Dame and the Engineering Materials Achievement Award of the American Society for Metals in 1975. In 1986 Frank received the National Medal of Technology of the U.S. Department of Commerce from President Ronald Reagan at the White House.

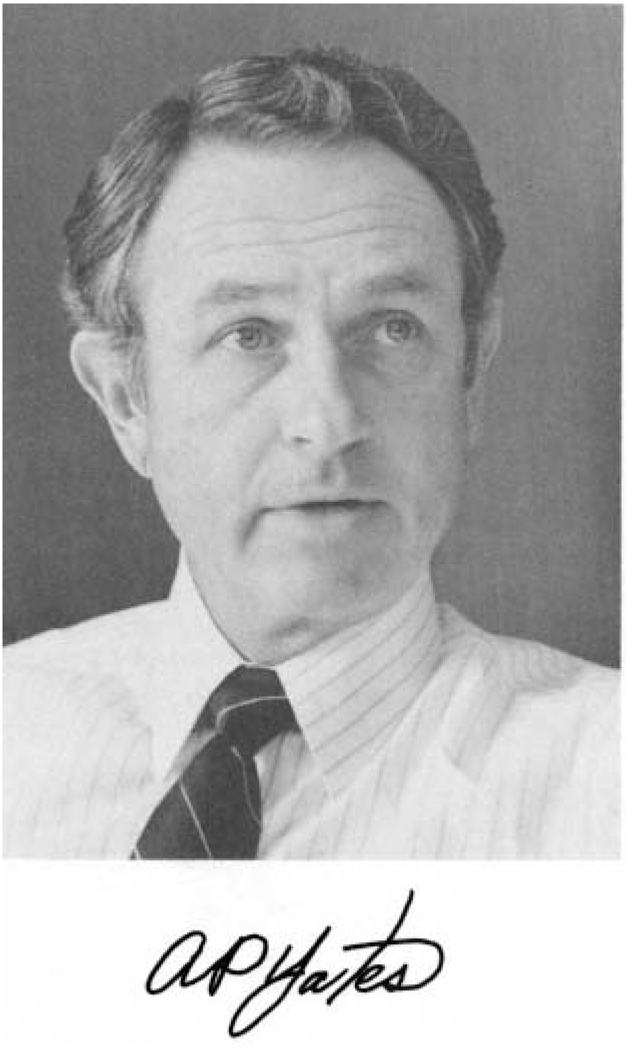
A few words must be said about Frank's World War II military service, which had a profound affect on his subsequent life and philosophical outlook. He served as a rifleman in the 54th Armored Infantry Division in the Mediterranean and European theaters of operations. Much of the time he served as a first scout —the soldier who is out in front of the men out in front. He volunteered for this assignment because he "didn't want anyone to tell him what to do." His campaign ribbons had four battle stars for the Central Europe, Rome-Arno, Southern France, and Rhineland Campaigns, plus a bronze arrowhead for the invasion of Southern France. He was decorated with the Purple Heart, with Oakleaf Cluster, for wounds received in action in May and October 1944. Frank was on many night patrols and on a bitterly contested beach head in Italy. Once, in a position overrun by the Wehrmacht, with two companions he hid for three days underneath the duckboards until the position was retaken. His companions suggested surren der, but he told them he would kill them before he would let them do so. Later in the war his division overran and defeated the Waffen SS unit that had committed the massacre of American troops at Malmedy, Belgium. He said that the battle was fought to the death, with no surrender and no prisoners. His final action was the liberation of a Nazi concentration camp.

These experiences in the face of battle, with life and death encountered in an intensity of emotion not known in peacetime, left memories that he could not bear to recall and yet could never forget. They left him with an ever-present sense of the inevitability of life and death. On several occasions, being notified that he was about to receive one of his numerous awards for professional achievements, he would quote from Thomas Gray, eighteenth-century author of "Elegy Written in a Country Churchyard": "...paths of glory lead but to the grave."

Withal, Frank was a man of great charm, with a wry and sometimes self-deprecating sense of humor, well read in philosophy and history. He had a fierce sense of independence and an extraordinary sensitivity to the motivations of those with whom he came in contact in the industrial world. Highly principled, he was concerned always that he take the right action for the right reason.

Frank was impressive as a professional colleague and charming as a friend. He had the skill and good fortune to change completely the technology of high-temperature metallurgy for gas turbines, thus opening a whole new area of research and development for others who today pursue the professional ramifications of his developments.

He is survived by three daughters, Connie Welling of Mt. Vernon, New York, and Christine and Kelly of Hamden, Connecticut; two grandsons, Justin and Alexander Welling; and his son-in-law Martin Welling.



Alden P. Yates

1928-1989

By William W. Moore

Alden P. Yates, vice-chairman of the Bechtel Group, Inc. and chairman of its executive committee, died on April 12, 1989, at the age of sixty at the Pacific Presbyterian Medical Center in San Francisco after a valiant struggle against cancer. Alden's life and career were closely tied to the Bechtel organization and to the engineering and construction industry. His father, Perry Yates, was a veteran of the Hoover Dam project and was also an important member of the Bechtel executive team. Alden spent his early years in the construction environment of the Hoover Dam project where his father was a construction engineer. Alden became excited at an early age about "the wonderful tools we have to help bring positive change to the world." His father later became executive vice-president of Bechtel, and as his career progressed the family traveled to various construction projects. Alden early had a summer job as a "junior expeditor," which he described as "riding a bike around the warehouse and grabbing parts." This experience with engineering and construction life provided "the perfect construction business baptism."

Alden earned his B.S. in civil engineering from Stanford in 1951 and was a member of Beta Theta Pi. Also while at Stanford, he met and married his wife, Dawn, and made many lifelong friends.

After serving as a lieutenant "JG" in the U.S. Coast Guard, Alden Yates began his thirty-five-year career with Bechtel in 1953. His first assignment was a field engineer at Pacific Gas & Electric's Morro Bay steam power plant in California. From that start he served in a broad variety of projects in the power, civil, and mining fields throughout the world, steadily working his way up through the company. In 1970 he was elected a vice-president and thus became a partner in the privately held Bechtel organization.

His responsibilities in the organization continued to increase through the 1970s. In 1976 he became manager of a Petroleum and Chemical Division based in Kuwait, and joined the board of directors of Bechtel the following year. When based in London in 1980, he was in charge of three Bechtel divisions and was elected to the company's executive committee.

In November 1980 Alden Yates was elected president of Houston-based Bechtel Petroleum, Inc. and was elected in May 1983 to president and chief operating officer of its parent company, Bechtel Group Inc., replacing George P. Shultz. Mr. Yates and Mr. Shultz were the only two non-Bechtel family members to hold the presidency of the parent company.

Alden Yates became chairman of Bechtel's executive committees in August 1984 and vice-chairman of Bechtel Group Inc. in 1989.

Steve Bechtel, Jr. noted "we have lost a valued leader and a special friend. Alden has personified this company's idea of excellence, dedication, and teamwork. His contributions to the Bechtel organization and to the engineering profession were significant and lasting." He also undertook personal efforts to "feel the pulse of the organization and hear what's on people's minds." When he heard too often that people felt unappreciated, he wrote in Bechtel's management notes that "in the pressure of these difficult times, most of us can forget to tell others that they have done a good job and are appreciated for their work. We should not take anyone for granted." He also noted that "a bright and prosperous course lies in our future-if we choose to seek it out." He added, "the members of the Bechtel Organization are not only the key to winning today's jobs but they are also the key to achieving the continuous improvement that will ensure tomorrow's jobs."

Outside of his career with Bechtel, Alden Yates was a major contributor to the engineering profession and to the communities where he lived and worked. The interests and welfare of the people working under his direction were always an important factor in his decisions and actions. Alden told the graduating seniors at Menlo College, Palo Alto, that they should travel and "get out and see for yourselves who shares this planet with you, how they live, why they think as they do. We are increasingly dependent on each other throughout the world and the sooner we all realize that fact the better we can solve the social, political, and economic problems that surround us."

Alden Yates was elected to the National Academy of Engineering in 1986. He was also a member of the Conference Board, the advisory council of Stanford University School of Engineering; the California Business Roundtable; and the American Society of Civil Engineers. He was a director of SRI International; United Way of the Bay Area; the National Council for Minorities in Engineering, Inc.; The San Francisco Opera Association; and the Bay Area Council. He was a trustee of the Pacific Presbyterian Medical Center and served as chairman of the San Francisco Bay Area Science Advisory Board.

Alden enjoyed spending weekends with his family at their ranch in Napa Valley of California where he played tennis and took an active interest in wine making, fly fishing, and golf.

He is survived by his wife of thirty-eight years, Dawn; their six children, Steven, Michael, Jeffrey, Russell, Karen Weiss, and Patricia Mitchell, all of California; and six grandchildren.

A memorial service for Alden was held April 18, 1989, at the Grace Cathedral in San Francisco.

Appendix

Members	Elected	Born	Deceased
William C. Ackermann	1967	October 7, 1913	June 9, 1988
Maurice Apstein	1977	May 5, 1910	March 16, 1987
William J. Bailey	1990	August 11, 1921	December 17, 1989
Harold E. M. Barlow	1979	November 15, 1899	April 20, 1989
Bernard P. Bellport	1970	May 25, 1907	October 3, 1987
Charles M. Brinckerhoff	1976	March 15, 1901	April 22, 1987
George H. Brown	1965	October 14, 1908	December 11, 1987
Nathan Cohn	1969	January 2, 1907	November 16, 1989
Henry J. Degenkolb	1977	July 13, 1913	December 9, 1989
Daniel N. Dietz	1988	November 7, 1913	April 15, 1988
Charles Stark Draper	1965	October 2, 1901	July 25, 1987
Harold E. Edgerton	1966	April 6, 1903	January 4, 1990
Martin A. Elliott	1976	February 21, 1909	August 5, 1988
Elliott M. Estes	1976	January 7, 1916	March 24, 1988
William L. Everitt	1964	April 14, 1900	September 6, 1986
Ulrich Finsterwalder	1976	December 25, 1897	December 5, 1988
James Brown Fisk	1966	August 30, 1910	August 10, 1981
Daniel W. Fox	1984	May 14, 1923	February 15, 1989
Richard S. Frank	1980	September 12, 1914	August 23, 1986
Giuseppe Gabrielli	1983	February 26, 1903	November 29, 1987
Eric T. B. Gross	1978	May 24, 1901	June 27, 1988
Jozsef Hatvany	1985	November 18, 1926	July 11, 1987
Robert A. Henle	1982	April 27, 1924	January 27, 1989
Lord Christopher Hinton	1976	May 12, 1901	June 22, 1983
Leroy Wallace Holm	1986	May 19, 1923	October 23, 1989
John A. Hornbeck	1975	November 4, 1918	January 30, 1987
Herbert H. Johnson	1987	July 16, 1931	October 1, 1989
Wilfred E. Johnson	1968	May 24, 1905	February 10, 1985
Bruce G. Johnston	1979	October 13, 1905	October 11, 1989
Donald LaVerne Katz	1968	August 1, 1907	May 29, 1989
Hugh S. Knowles	1969	September 23, 1904	April 21, 1988
Wesley A. Kuhrt	1980	December 27, 1917	October 19, 1988
James N. Landis	1964	August 18, 1899	April 29, 1989
Francis Lawrence LaQue	1985	July 21, 1904	January 19, 1988
Joel Franklin Monroe Leathers	1978	January 10, 1920	June 1, 1987
W. Deming Lewis	1967	January 6, 1915	April 19, 1989
Frederick C. Lindvall	1967	May 29, 1903	January 17, 1989

Members	Elected	Born	Deceased
John Routh Low, Jr.	1978	February 19, 1909	August 28, 1988
W. Robert Marshall	1967	May 19, 1916	January 14, 1988
Stanley G. Mason	1980	March 20, 1914	April 21, 1987
John Francis McCarthy, Jr.	1981	August 8, 1925	February 7, 1986
Otto Neil Miller	1968	January 20, 1909	February 4, 1988
Philip McCord Morse	1985	August 6, 1903	September 5, 1985
William Henry Mueser	1978	April 10, 1900	June 25, 1985
Morrough Parker O'Brien	1969	September 21, 1902	July 28, 1988
William S. Pellini	1974	May 4, 1917	February 25, 1987
Robert L. Pigford	1971	April 16, 1917	August 4, 1988
Milton Pikarsky	1973	March 28, 1924	June 15, 1989
W. Duncan Rannie	1979	May 21, 1914	August 13, 1988
Stephen O. Rice	1977	November 29, 1907	November 18, 1986
Joe B. Rosenbaum	1973	March 1, 1912	September 12, 1987
Claude P. Seippel	1984	June 14, 1900	August 1, 1986
J. George Thon	1975	December 6, 1908	September 6, 1988
Francis Louis VerSnyder	1981	May 27, 1925	November 28, 1989
Alden P. Yates	1986	July 12, 1928	April 12, 1989

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