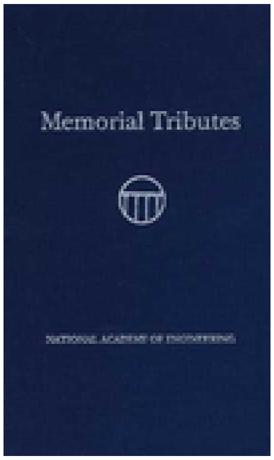

Memorial Tributes: National Academy of Engineering, Volume 7

National Academy of Engineering

ISBN: 0-309-57335-1, 256 pages, 6 x 9, (1994)

This PDF is available from the National Academies Press at:
http://www.nap.edu/catalog/4779.html

Memorial Tributes

NATIONAL ACADEMY OF ENGINEERING

Memorial Tributes

Volume 7

NATIONAL ACADEMY OF ENGINEERING OF THE UNITED STATES OF AMERICA

NATIONAL ACADEMY PRESS
Washington, D.C. 1994

International Standard Book Number 0–309–05146–0
International Standard Serial Number 1075–8844

Library of Congress Catalog Card Number 92–645111

Additional copies of this publication are available from:
National Academy Press
2101 Constitution Avenue, N.W.
Box 285
Washington, D.C. 20055
800–624–6242 or 202–334–3313 (in the Washington Metropolitan Area)

B-467

Printed in the United States of America

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FOREWORD

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

Simon Ostrach

Home Secretary

Memorial Tributes

NATIONAL ACADEMY OF ENGINEERING

ISAAC L. AUERBACH

1921–1992

BY JORDAN J. BARUCH

ON DECEMBER 24, 1992, with the death of Isaac L. Auerbach, the world simultaneously lost a skilled, creative engineer; a special breed of philanthropist; an entrepreneur, consultant, and teacher; and an artist in the demanding world of color photography.

Isaac was born in Philadelphia, Pennsylvania, on October 9, 1921. He received his B.S. in electrical engineering from Drexel University in Philadelphia in 1943 and spent the war years from 1943 to 1946 in the U.S. Navy.

During his stay in the navy, he was introduced to his future in electronics working on the Mark V IFF system at the Naval Research Laboratory in Washington, D.C., and to his future as a leader serving as a lieutenant (junior grade) aboard a destroyer escort in the North Atlantic.

After the war Isaac attended Harvard University, where he received an M.S. in applied physics. After graduation Isaac worked with the Eckert Mauchly Computer Corporation (later Sperry-Univac), where he was one of the designers of the BINAC and UNIVAC computers.

After Sperry, Isaac spent eight years at Burroughs, where he formed and directed the Defense, Space, and Special Products Division. Among his major accomplishments there, were the first real-time, transistor-based guidance computer system for the U.S. space program and a continuing series of ever-more powerful encryption and decryption computers for the U.S. government.

By 1957 Isaac had had enough of working for others and struck out on his own. He then established the Auerbach Corporation for Science and Technology. Under the rubric of that corporation and independently, Isaac, as a pioneering entrepreneur in the computer field, founded and headed more than a dozen successful companies.

Among the best known of these was Auerbach Associates Inc., one of the earliest computer system design and consulting firms in the United States. Specializing in real-time systems, the firm was responsible for a new air-traffic control system for the Federal Aviation Administration, the earliest airline reservation system, and every computer in the U.S. Ballistic Missile Early Warning System. Personally, Isaac was a successful inventor, holding sixteen U.S. and foreign patents in the digital computer field.

Another firm that he founded, Auerbach Publishers Inc., produced a world-renowned series of loose-leaf information services covering computer technology, information management, and computers in manufacturing. These services updated information monthly and distributed it on six continents. The information eventually came to fill thirty-seven substantial binders, which essentially defined the computer industry.

As reflected in his consulting and his publishing, Isaac recognized how important communication among professionals was to the development of the information field. He pulled together forty-eight professional societies from fifteen countries and in 1960 founded (and served as the first president of) the International Federation for Information Processing. He was elected their first honorary life member in 1969.

Among Isaac's many other honors were his election as a fellow of the American Association for the Advancement of Science, a distinguished fellow of the British Computer Society (personally conferred by the Duke of Kent), a trustee of the Charles Babbage Institute, a fellow of the Institute of Electrical and Electronics Engineers, and an honorary member of the Information Processing Society of Japan.

However, Isaac claimed that his greatest satisfaction came with his election to the National Academy of Engineering in 1974. Isaac saw it as the ultimate in recognition from his peers. In the Academy, Isaac served on five committees and chaired the Public Information Advisory Committee. This renaissance man not only participated in and guided the work of the Academy, but in 1977 he also delighted us with an exhibit of forty-four color photographs hailed by such publications as *Art in Focus*. An article in that magazine summed up the feelings of many about his photography: "[Isaac] feels and sees as might a contemporary master of the brush."

Fortunately for us, Isaac's technical leadership was matched by his civic and philanthropic leadership. In 1976 Isaac started his service on the Technical Advisory Board of the U.S. Department of Commerce, where he served with distinction. His contributions were particularly important in the board's work on formulating policies to stimulate technological innovation—an area where his personal experience was exceptionally valuable. He also served as a valuable adviser to the cities of Philadelphia and Washington.

Much of Isaac's attention was focused on helping educational and other charitable organizations. Domestically, Drexel University, Dropsie University, the University of Pennsylvania (where he also taught entrepreneurship at the Wharton School), Georgia Institute of Technology, and the Institute for Mental Health Initiatives all benefited from his commitment. Isaac gave freely of both his time and his material resources.

Israel was a particular focus of Isaac's efforts. He was a national president of the American Associates of Ben-Gurion University of the Negev and, in fact, became the vice-chairman of the Board of Governors of the university in 1988. Among the others who benefited were the Hebrew University, the Technion, and Boys Town of Jerusalem (where the Isaac L. Auerbach School for Computer Technology was founded in 1973).

As it would be impossible to list his technical papers and contributions, so this list of his civic and philanthropic con tributions must end. Yes, in 1992, the world lost an accomplished, multifaceted man. A family lost a husband, father, brother, and guiding figure. I, and many others, lost a friend.

Photograph by Blackstone-Shelburne.

WALTER C. BACHMAN

1911–1991

PREPARED WITH THE ASSISTANCE OF THE NAE MEMBERSHIP OFFICE SUBMITTED BY THE NAE HOME SECRETARY

WALTER C. BACHMAN, who played a senior part in the performance of Gibbs and Cox, Inc. and specialized in the design of ship propulsion machinery, died March 1, 1991, at the age of seventy-nine.

Born in Pittsburgh, Pennsylvania, Bachman received a B.S. degree (cum laude) in industrial engineering in 1933 and an M.S. degree in mechanical engineering in 1935, both from Lehigh University. After working as a graduate assistant instructor of mechanical engineering at Lehigh, Bachman joined the Federal Shipbuilding and Drydock Company in 1935 as an engineer, then left in 1936 to join the naval architectural firm of Gibbs and Cox, where he spent the remainder of his professional career.

While at Gibbs and Cox, Bachman's specializations included marine engineering, ship design, ocean engineering, and power generation. In particular, he concentrated on the design of ship propulsion machinery and made important contributions to many advanced naval and merchant marine machinery installations, which included the superliner SS *United States*. Bachman actively engaged in all phases of the design of ship propulsion machinery. He devoted particular attention to developing and improving methods of analysis of stresses, vibration characteristics, and thermodynamic performance of marine machinery and also to organizing and refining methods for designing and predicting the hydrodynamic performance of ships. His methods were applied to many of the naval and merchant ships designed by Gibbs and Cox, including its multiple shipbuilding programs; most destroyer types in the U.S. Navy; several advanced experimental marine power plants; the SS *United States*, which held the Atlantic speed record; and various other projects, including floating oil drilling platforms, the platform for the MOHOLE Project, and unusual ship types.

Bachman played a leading part in the design, engineering, and preparation of working plans for such various U.S. Naval ships as destroyers and guided missile destroyers, destroyer escorts, frigates and guided missile frigates, cruisers, aircraft carriers, landing craft, icebreakers, minesweepers, and numerous auxiliary ships such as destroyer tenders and submarine tenders. For commercial shippers, he did similar kinds of work on the SS *America*, SS *United States*, SS *Santa Rosa* and *Santa Paula*, British cargo ships, Liberty ships, and numerous other cargo ships.

In certain areas of his work on ship propulsion characteristics and machinery plants Bachman was particularly active. He developed an improved analytical method for ship propeller shaft alignment, applied the results of his extensive study of the various forms of ship vibration to many successful ship designs in both the machinery plants and the hull forms, and supervised correction of "singing" propeller vibration for a fleet of British cargo vessels in World War II. He developed a procedure for predicting the reversing characteristics required for the design of experimental diesel electric destroyer machinery for the USS *Watson* and made numerous studies leading to the design of an experimental reheat steam power plant that was tested full scale at the Naval Boiler and Turbine Laboratory for the USS *Percival*. He also took a leading part in guiding the many studies required for the development of advanced high-pressure, high-temperature steam machinery for the USS *Timmerman*, a design that extensively influenced all surface ship steam machinery in the U.S. Navy after World War II. In addition, he developed methods for predicting the hydrodynamic performance of ships and improved designs of both subcavitating and supercavitating propellers; took a leading part in developing the machinery plants for the SS *United States* and many merchant ships; and made and guided extensive design studies of gas turbine propulsion machinery for many ships, including the GTS *John Sargent*, HS *Victoria*, and several combatant types for the U.S. and Canadian navies.

Elected to the National Academy of Engineering in 1967, Bachman served on the National Research Council's Committee on Ocean Engineering and was chairman of its Panel on Commerce and Transportation. A licensed professional engineer, he was a fellow of the American Society of Mechanical Engineers and served on many of its technical committees. He was a member of the American Society of Naval Engineers, National Society of Professional Engineers, and the Engineering Committee of the American Bureau of Shipping. Also a member of the Society of Naval Architects and Marine Engineers, he was an active participant in that society's technical and research program, serving as chairman of its Committee for Hydrodynamic Research and as a member of its Technical and Research Steering Committee. Bachman also served as a member of the Mechanical Engineering Advisory Committee of Norwich University.

The late William Francis Gibbs earlier recalled his association with Bachman. "The results of the work of this firm, as shown in the design of ships for the national defense, in vast numbers of cargo ships and passenger ships such as the SS *United States*, indicate better than I could describe the senior part that Mr. Bachman has played in the performance of the firm. It is the opinion of many that he is easily the best and foremost marine engineer in the world today. If modesty be a fault, he can plead guilty."

Bachman is survived by his son, Van Cleaf Bachman of Lunenberg, Nova Scotia; a daughter, Elizabeth Ramjoué of Oberhaching, Germany; six grandchildren; and three great-grandchildren.

HORACE SMART "BUD" BEATTIE

1909–1993

BY ROBERT M. DRAKE, JR., AND WILLIAM RILEY

ON SEPTEMBER 6, 1993, Horace S. "Bud" Beattie, who retired as vice-president of engineering, Office Products Division of the International Business Machines (IBM) Corporation some twenty years earlier, passed away at his thoroughbred horse farm in Lexington, Kentucky. Mr. Beattie, or Bud as everyone knew him, was employed by IBM for over forty years and served as a consultant many years after he retired. Mr. Beattie received the American Society of Mechanical Engineers Medal in 1971 and the Engineering Citation of the Society of Manufacturing Engineers in 1973. He was elected to the National Academy of Engineering in 1976.

Upon elevating Bud to the level of IBM corporate vice-president in 1972, IBM Chairman Thomas J. Watson, Jr., said, "Bud, you are one of the two or three most creative engineers and inventors *ever* to be in IBM . . . and in addition you're a great leader of men." W. J. Maloney, retired IBM vice-president, recently commented that "everyone who knew Bud, from the chairman to the newest engineer, agreed with this appraisal of this very unique man." Mr. Maloney went on to say that "Bud was not only the proverbial engineer's engineer but was well ahead of his time in leading and motivating an engineering division. You could never catch Bud in his office before 10:30 or 11:00 in the morning . . . because from 8:00 to 11:00 every day he went into the laboratories to keep himself abreast of the projects and to keep in touch with all his engineers." "Bud wasn't encroaching on his managers," Maloney insisted, "he would walk around the labs and ask the project engineers what they were working on, and how it was going." If they were having problems, he would frequently suggest alternatives that might be tried and express support for their efforts and enthusiasm. Later he'd return to inquire about the progress because engineering and engineers were what made Bud happy, and it was not unusual to hear a junior engineer call this vice-president and say "Hey Bud, I tried that suggestion we talked about, and it worked!" And, Bud Beattie took as much pleasure in this as he did in any facet of his difficult and complicated job. "He didn't like to push people . . . or order people, although he could do that too, when necessary. He liked to help and lead people. . . . That's why he was so good at his job," Maloney stated.

Bud Beattie joined IBM in June 1933 as a customer serviceman. By this time he was a graduate of the Hotchkiss School, had a B.A. from Williams College, and had a B.S. from the Massachusetts Institute of Technology. In 1934 he was promoted to draftsman and detailer and later to engineer. He worked in the IBM lab in East Orange, New Jersey, where he coordinated development of new products with Thomas J. Watson, Sr., founder of the IBM Corporation. During this period Bud was instrumental in the development of the IBM 709 calculating machine, viewed by many as the foundation of IBM computers. He held some significant patents in conjunction with Mr. Watson but also individually held thirty-nine U.S. patents. After successfully completing assignments as manager of product development and as lab manager in Poughkeepsie, New York, Mr. Beattie was named lab director for the new Electric Typewriter Division with headquarters in Lexington, Kentucky, in 1957. Under his guidance the IBM electric typewriter became the standard of the industry because of its quality and technology. But, Bud couldn't satisfy his creativeness with typing alone, so his labs developed new product lines for IBM —including printers, dictation equipment, copiers, and automatic storage typewriters—which forced the corporation to change the division name from Electric Typewriter Division to Office Products Division. However, Bud's best-known creation was what T. J. Watson, Jr., called "the most totally distinct invention we've ever made as a company"—the single-element printer. "This," Mr. Watson said, "is the most significant change in typing in 120 years."

Bud personally solved many of the problems inherent in the original invention of the single-element print mechanism that not only produced the electric typewriter but became the basis for countless printers and led to IBM's memory typewriters and correcting typewriters. In a 1986 article on office communications, *USA Today* said Mr. Beattie "changed the office landscape forever."

Bud spent his retirement years with his wife, Lois, alternating between his winter home in Florida and his thoroughbred farm outside Lexington. His daughter, Susan Hill, is in Chevy Chase, Maryland, while his son Peter lives in Lexington, and his son William resides in Dunedin, Florida. He has four grandsons.

He served on the board of directors of the University of Kentucky Research Foundation and on the advisory council of the University of Kentucky's College of Engineering. He was a member of the Thoroughbred Club of America, the Keeneland Club, and the Lexington and Idle Hour Country Clubs.

Bud will be remembered by his friends as a brilliant man who not only never flaunted his brilliance, but was almost embarrassed by it. He was a good friend, with a quick happy laugh, who enjoyed nothing more than a good time with his good friends.

MELVIN BOBO

1924–1993

BY FRANK E. PICKERING

MELVIN BOBO, a retired chief engineer for General Electric (GE) Aircraft Engines, died on October 27, 1993, at the age of sixty-nine.

Mr. Bobo was born in Blair, Texas, on February 13, 1924. He served as an infantry medical aide in Europe during World War II. He received his B.S. degree in mechanical engineering in 1949 from Texas Tech University, where he was also elected to the engineering honor society, Tau Beta Pi. He became a registered professional engineer in the state of Ohio in 1954.

Mr. Bobo joined the General Electric Company in 1949 and went on to devote his entire career to the design and development of GE aircraft engines. He retired in 1991.

For over four decades, Mr. Bobo was at the forefront in the design and development of aircraft engines, which powered many of the nation's most advanced military and commercial aircraft.

As a young engineer, Mr. Bobo made important contributions to the designs of the turbines and compressor for the supersonic J79 engine, which set new standards of performance and reliability with a wide range of military applications, including the B-58 bomber, the F-104 fighter, and the famed F-4 "Phantom" fighter. The J79 core was later produced as the gas generator for the CJ805 commercial turbojet, which powered the Convair 880, and the CJ805-23, one of the first

U.S. turbofan engines, which entered commercial service on the Convair 990 in the early 1960s.

In the early 1960s Mr. Bobo managed turbine design engineering for small engines and later led the design of an advanced T58 turboshaft engine for military and commercial helicopters. These engines were greatly enhanced by his innovative application of advanced cooled turbine technology for small engines.

In the late 1960s Mr. Bobo designed the turbine and managed the engine design of the GE4, which was a prototype for a supersonic transport engine. Although this program never reached the production stage, significant technology advances developed and demonstrated by the GE4 benefited the design and development of other future high-performance engines.

In 1971, as manager of CFM56 engineering for General Electric, he collaborated with the CFM56 engineering team at SNECMA of France to establish the design of the coventure CFM56 commercial turbofan engine. The CFM56 program went on to anchor a very substantial and successful French/American coventure with a family of engines, which now power aircraft for more than 175 operators all over the world.

During the next ten years, Mr. Bobo led engineering design teams at General Electric focused on the design and development of the turbomachinery of the CFM56 and CF6 engine models and the engine design of the advanced CF6 models, the CF6-80A and CF6-80C engines. These engines set new standards and are major contributors to the reliability and economy of modern air transportation.

From 1985 until his retirement in 1991, Mr. Bobo, as chief engineer at GE Aircraft Engines, provided oversight for the engineering excellence of all of General Electric Aircraft Engine products and developments as well as for its flight safety and engine certification activities. In this capacity he made important technical contributions and also provided leadership, guidance, and training to a host of aircraft engine design engineers. After retiring, Mr. Bobo continued to serve GE Aircraft Engines from time to time as an expert engine design consultant.

Over his entire career, Mr. Bobo contributed significantly to the design and development of advanced gas turbine engines and made many lasting contributions to the technology and design concepts for modern turbomachinery engines. He was awarded more than thirty-five patents, and he was a leader in the advancement of the design of reliable, high-temperature, high-performance turbomachinery. He made several unpublished presentations, including "Designing Safety and Ruggedness into Aircraft Engines" at the ATA (Air Transport Association) Engineering and Maintenance Forum in 1986 and "The Evolution of Kevlar Containment Systems" at the Society of Automotive Engineers Aerotech Conference in 1987. He was a member of the AIA (Aerospace Industries Association) Aviation Division Committee on Aging Aircraft. In addition to his industry affiliations, Mr. Bobo was also involved in civic and church activities and was a member of the board of directors of the Midwest Children's Home.

Mr. Bobo was widely recognized and honored by his associates in the engineering community. He received the GE Aircraft Engine Engineering Award for community service in 1972, the prestigious General Electric Steinmetz Award for distinguished engineering accomplishments in 1981, the Distinguished Engineer Award by the Texas Tech University in 1988, and the GE Gold Medallion Patent Award for his many inventions. Mr. Bobo was elected to the National Academy of Engineering in 1991 and was inducted posthumously into the GE Aircraft Engines Hall of Fame in 1993.

Mr. Bobo loved his family, his work, and the industry he served so well. He contributed a vast amount to the conception, design, development, and engineering of advanced aircraft engines while, at the same time, effectively leveraging his excellent capability through the setting of high technical and ethical standards and the giving of himself to the guidance, motivation, and leadership of others.

RAY H. BOUNDY

1903–1992

BY ROBERT M. NOWAK

RAY H. BOUNDY, a former vice-president and director of research for the Dow Chemical Company, died in Midland, Michigan, on November 19, 1992. A pioneer in industrial chemical research, Dr. Boundy used his creative genius and leadership skills to build one of the most innovative research organizations in the country.

Dr. Boundy was born in Brave, Pennsylvania, on January 10, 1903. The Boundy family later moved to Grove City, Pennsylvania, where Dr. Boundy graduated from Grove City College in 1924 with a bachelor of science degree in chemistry. He initially considered a career as a ship's radio engineer but heeded a chemistry instructor's advice to pursue science instead. He then attended Case Institute of Technology, receiving bachelor's and master's degrees in chemical engineering. In 1926—the same year he married the former Geraldine McCurdy—Dr. Boundy also began his forty-two year career at the Dow Chemical Company.

After working in the Dow Main Laboratory for only one year, Dr. Boundy was "borrowed" by the Physical Research Laboratory, which was experiencing a remarkable outburst in creativity and discovery—especially in the fields of organic chemistry and plastics. Dr. Boundy worked closely with laboratory director and "idea man" Dr. John Grebe, becoming assistant lab director in 1930. One of Dr. Boundy's main tasks, he said, was to sift through John's ideas and help "pick out those that were good from those that weren't."

In 1942 Dr. Boundy became an assistant to Dow President Willard H. Dow and was put in charge of building and managing styrene facilities in the United States and Canada. This was instrumental in helping Dow—and others—produce the styrene urgently needed for the government's wartime rubber reserve program. At war's end, Dr. Boundy served as a colonel in the U.S. Army, traveling to Germany to study and report on Axis wartime developments in plastics. He also served as a U.S. representative for the Rubber Reserve and Technical Industrial Intelligence Committees.

In 1945 Dr. Boundy was appointed manager of Dow's rapidly expanding Plastics Department—the first of Dow's product departments. In 1947 he received an honorary doctor of science degree from Grove City College for his notable contributions in the field of organic chemistry. In 1950 he was elected to the Dow board of directors and in 1952 he became the company's first full-time director of research. He was named a vice-president of the company in 1953. After retiring from Dow in 1968, he continued to have a positive influence on the growth of science as a research management consultant through the International Executive Service Corps.

As a researcher, administrator, and author, Dr. Boundy made many contributions. He was active in the following areas, for example: the invention of DOWTHERM heat transfer fluids, the Dow process for extracting bromine from seawater, the use of ferric chloride as a coagulant in treating municipal water and sewage, and the development of the Dow processes for manufacturing ethylene and ethylene-based products. Dr. Boundy was responsible for fifteen patents and numerous publications in technical journals. He also coauthored the books *Styrene: Its Polymers, Copolymers, and Derivatives* in 1952 and *A History of the Dow Chemical Physics Lab: The Freedom to be Creative* in 1990.

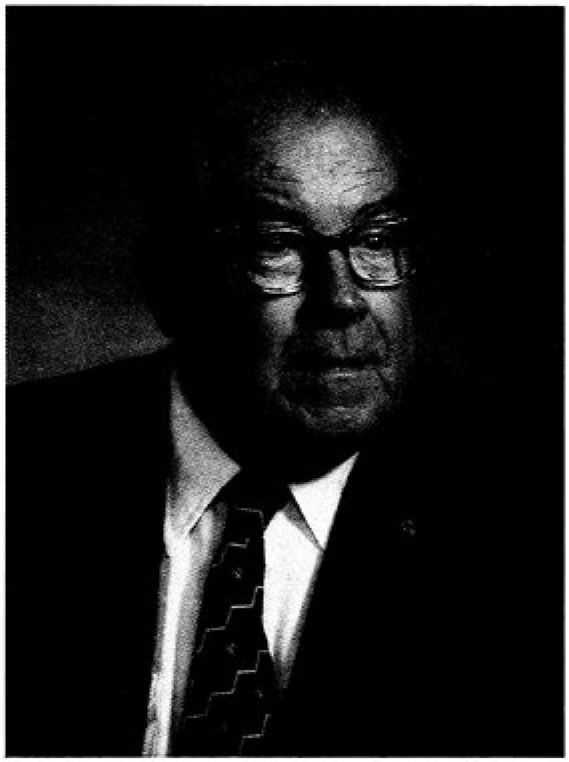
In the latter book, Dr. Boundy reflects on the importance of creativity, and how it exists in everyone. All that's needed, he said, is a little encouragement. Dr. Boundy gave encourage ment, motivation, and accountable freedom to young and seasoned scientists alike. He was renowned for his accessibility to others throughout his career, and had avid enthusiasm for individuals as well as for projects. Dr. Boundy is described by colleagues as a man who had excellent judgment on both technical and business matters, accurate instincts about new product families, and a management philosophy that guided, rather than dictated, research conclusions.

Dr. Boundy is remembered as an innovative research administrator who introduced concepts that profoundly affected the business, operations, and success of Dow. As examples, he introduced the product department concept to Dow, organized the first technical service laboratory, and developed world-class and worldwide technical service organizations. He also developed the company's long-range market research program, organized its Research Economics Department, and contributed to the company's research evaluation methods.

In 1964 Dr. Boundy received the Industrial Research Institute Medal for outstanding accomplishment in the leadership and management of industrial research. In 1965 he received a Scroll Award from the National Association of Manufacturers, which recognized him as a modern pioneer in creative industry. He also received an Alumni Achievement in Science Award from Grove City College.

In 1967 Dr. Boundy was elected to the National Academy of Engineering. He was also a member of the American Chemical Society, the American Institute of Chemical Engineers, the Electrochemical Society, the Engineering Society of Detroit, the Scientific Research Society of America, the Society of Automotive Engineers, and many other associations.

The productive enthusiasm of Ray Boundy—an enthusiasm also extended to his family and community as Boy Scout leader, softball catcher, trout fisherman, bird hunter, ham radio operator, and avid skier—will long be remembered and appreciated by Dow, the chemical industry, and his family and friends.



RAYMOND F. BOYER

1910–1993

BY ALFRED E. BROWN

RAYMOND F. BOYER, world renowned polymer physicist, died on February 23, 1993, at the age of eighty-three.

Dr. Boyer was born on February 6, 1910, in Denver, Colorado, but was raised in Canton, Ohio. He attended Case Institute of Technology, where he received his B.S., M.S., and honorary D.Sc. degrees. Dr. Boyer joined the Dow Chemical Company in 1935, and in 1952 he became director of research in the newly formed Plastics Department. He then became assistant director of corporate research in 1969. He remained in that position until his retirement from Dow in 1975.

A pioneer in polymer physics and engineering, Dr. Boyer authored or coauthored more than 160 publications. He was also the inventor or coinventor of twenty-two U.S. patents. Particularly noteworthy were his contributions to styrene polymers and their utilization in styrene plastics. His pioneering work correlating thermal expansion and second-order transition temperature in polymers led to improved understanding of molecular motion in high polymers. He is widely known for his work in the development of stabilizers for polystyrene and the definition of mechanical properties of polymers. His work with plasticizers was instrumental in the development of Saran. His studies of solution viscosity led to better understanding of polymer interactions. He also pioneered in the light and heat stability of plastics and studies of the usefulness of plastics in electrical applications. He also directed research groups that developed many new plastic products, including high-impact polystyrenes and Styrofoam.

Dr. Boyer participated in activities of diverse organizations, including those of the National Research Council (NRC) or the National Academy of Sciences (NAS), government agencies, professional societies, and universities. For the NRC Materials Advisory Board, he chaired the following two committees: the Panel on Polymers of the Committee on Characterization of Materials and the Ad Hoc Committee on Opportunities in the Basic Materials Industries. He also chaired the NRC Panel on Polymers, an evaluation panel for the National Bureau of Standards. He was a member of the NAS Committee on the Survey of Materials Science and Engineering and of the NRC Committee on Renewable Resources for Industrial Materials. He served the National Science Foundation (NSF) on the Advisory Panel on Funding of Polymer Science. He chaired the High Polymer Divisions of both the American Chemical Society (ACS) and the American Physical Society, and was twice chairman of the ACS Biennial Polymer Symposium. He was a member of the Macromolecular Committee of the International Union of Pure and Applied Chemistry and a member of the advisory boards of the *Journal of Applied Polymer Science; Journal of Macromolecular Science, Physics*; and the *Journal of Macromolecules*. In addition, Dr. Boyer was invited to lecture on polymer science and technology at many universities and conferences worldwide.

While at Dow, Dr. Boyer received the International Award—and its associated gold medal—of the Society of Plastics Engineers (1968); the ACS Award in the Chemistry of Plastics and Coatings sponsored by Borden Foundation, Inc. (1970); and the biennial Swinburne Award of the Plastics and Rubber Institute of Great Britain (1972). Also in 1972 he was named Dow Chemical's first research fellow, Dow's highest scientific honor.

In 1978 Dr. Boyer was elected to the National Academy of Engineering in recognition of his outstanding contributions to the field of high polymers and to the industrial development of plastics technology.

After retiring from Dow at age sixty-five, Dr. Boyer started a new career as an affiliate scientist at the Michigan Foundation for Advanced Research, now the Michigan Molecular Institute (MMI), of which he is a "founding father." In 1989 he was named the institute's first distinguished research fellow. Two years later he was inducted into the Plastics Hall of Fame.

In 1992 the MMI board of directors honored Dr. Boyer for his many years of interest and support in a special resolution:

[He] provided experience, insight, enthusiasm, and a rare blend of common sense and uncommon intelligence to his fellow researchers . . . as an inspired and inspiring teacher, [he] has enhanced the lives and careers of hundreds of scientists and engineers.

Dr. Boyer was loved not only for his research efforts but also for his unusual wit, humor, and compassion. I shall miss him very much as will many of his colleagues.

JOHN VALENTINE BREAKWELL

1917–1991

BY RICHARD H. BATTIN

JOHN VALENTINE BREAKWELL, professor of astronautics at Stanford University, died on April 16, 1991, at the age of seventy-three. John was admired and respected throughout the community of guidance, control, and astrodynamics specialists. His contributions have been fundamental and broad. He was a rare combination of the scholarly professor and the practical engineer. His modest and unassuming manner, coupled with a giant intellect, endeared him to all his colleagues and students.

Elected to the National Academy of Engineering in February 1981, John will be remembered as a key founder and major developer of astrodynamics. During a career spanning more than four decades, he was one of the most skillful contributors in trajectory optimization, differential-game theory, and their aerospace applications.

John was born in Ville Nueve, Switzerland, on December 6, 1917. He received his B.A. with first-class honors in mathematics from Oxford University in 1939. England was then at war, and John left for the United States in 1941 to become an instructor (later assistant professor) in applied mathematics at Tufts University in Medford, Massachusetts. At the same time he was a doctoral student at Harvard University and received his Ph.D. in mathematics from Harvard in 1947.

John was attracted to the new field of ballistic missiles, but a security clearance was required for classified work. He applied for U.S. citizenship, and it was granted in 1949. Then he moved to the West Coast to join the North American Aviation Corporation in Downey, California, to be a part of their missile development activities under contract with the U.S. Air Force.

In 1957, the year of the Russian Sputnik, John left for Sunnyvale, California, to become a member of the staff of the Lockheed Missiles and Space Company. The advent of the Space Age provided inspiration for the wealth of contributions for which John will always be remembered.

Early in his career John demonstrated an ability for profound insight. One of his early internal memos at Lockheed gave a detailed description of how the earth's gravity gradient could be used passively to stabilize the attitude of a satellite as well as to damp its oscillations.

The major program at Lockheed when John arrived was to construct the first American military satellite—the *Discoverer*. There were many engineers and scientists who contributed as a team to the design and development that made that program a success. John, however, worked as an individual and tackled some of the most difficult analytical problems that the satellite field had to offer. Applying his extensive mathematical ability and technical insight, he developed methods that would support the design basis for many future satellite programs, such as the Agena.

John published the first paper on trajectory optimization using the calculus of variations in 1959 to address the new problem of placing an artificial satellite in orbit. His continuing work in optimization theory led to a wide range of applications—missile trajectories, aircraft flight-path optimization, and interplanetary flight.

In 1964 John accepted an appointment to the faculty of Stanford University and there continued the research begun at Lockheed. But now he had the opportunity to influence many Standford graduate students who were fortunate enough to have him as their teacher and adviser. The roster of his past students reads like a *Who's Who in Astrodynamics*.

The invention of "halo orbits" (small, closed orbits in the vicinity of the Lagrange libration points) is attributed to John

Breakwell. In 1978 one of the Sun-Earth collinear points was used as the center of a halo orbit by a spacecraft known as the International Sun-Earth Explorer. One of his former students, Robert Farquhar, directed that project at the NASA Goddard Space Flight Center. John was also an important contributor to the joint NASA/Stanford Gravity Probe-B experiment designed for a new test of Einstein's theory of general relativity. It is intended to be launched from the space shuttle sometime in the next few years.

With Rufus Isaacs, John significantly advanced the modern theory of differential games. His famous 1969 paper on the "homicidal chauffeur" is a classic in that field. The work had important applications for the U.S. Air Force. It could be used to suggest possible "minimax strategies" for aerial "dogfights" between jet fighter aircraft.

John was recognized for his many outstanding achievements by the American Institute of Aeronautics and Astronautics (AIAA) with its Mechanics and Control of Flight Award in 1972. This was followed in 1974 by the American Astronautical Society presentation of the Dirk Brouwer Award for significant technical contributions to spaceflight mechanics and astrodynamics. Later he received the Humboldt Research Award for U.S. Scientists for 1977–1978.

Professor Breakwell supported his profession well through his service as an editor of the *Journal of Optimization Theory and Applications*, the journal of *Celestial Mechanics*, and the *AIAA Journal*. For several decades he was the astrodynamics session organizer for the annual International Astronautical Congress.

John Breakwell loved new and interesting problems to such an extent that many of his important technical contributions were never published in archival journals. He was simply too busy with something else to bother with the details of submitting papers for publication. As a result, one must often seek out various conference proceedings to locate some of his finest work.

Besides being a remarkable and inspirational teacher, John was an avid outdoorsman, hiker, and golfer. He was an accomplished musician and singer. He spoke French well enough to lecture in that language and could converse in many other languages as well. He had hoped to learn Mandarin Chinese in time for a conference in Beijing.

On the piano John could play almost any song that anyone could name and was also a fine choral singer. It is difficult to imagine how he could play the accompaniment in any key and sing any part of a choral work simultaneously. He loved Gilbert and Sullivan and sang the lead in several of their operettas produced at Stanford, including the judge in *Trial by Jury* and the major general in *The Pirates of Penzance*. He could—and frequently would—sing from memory many of the famous "patter songs."

John had a marvelously droll sense of humor, and it was truly a delight to hear any of his many anecdotes—always told with wonderful accents and authentic dialects. I will never forget the story of his misadventures in Greece when he fell into the company of some unsavory Athenians.

John Breakwell was a wonderful friend, unpretentious, generous, and kind. It was a pleasure to know him and he will be sorely missed.

SOLOMON JAN BUCHSBAUM

1929–1993

BY ROY W. GOULD

SOLOMON JAN BUCHSBAUM, senior vice-president, technology systems, AT&T Bell Laboratories, and adviser to the administrations of five U.S. presidents, died of multiple myeloma on March 8, 1993, at the age of sixty-three.

Sol, as he was known to his friends, was born in Stryj, Poland, on December 4, 1929. He lost both parents and a sister in the holocaust, and his early life was difficult. He emigrated to Canada in 1947 and received his bachelor's and master's degrees from McGill University in 1952 and 1953, respectively. He received his Ph.D. degree in physics from the Massachusetts Institute of Technology (MIT) in 1957. In 1955 he married Phyllis Isenman, and they had three children, Rachel Joy, David Joel, and Adam Louis. Sol became a U.S. citizen in 1963.

Sol cared deeply about the health of the U.S. technical enterprise, including the universities, government, and private research and development laboratories that compose it. His contributions were always distinguished by his personal enthusiasm, energy, and competitive spirit and by an uncompromising devotion to technical excellence and personal integrity. As a leader and adviser for large scientific-technological programs, he brought keen insights into technical issues and policy matters alike, quality judgment, and an ability to apply reason to very complex and difficult situations. He was remarkably able to convey his insights to others. He made many friends.

Sol's service to the technical community and to the U.S. government was recognized by his selection for two of the highest American honors in engineering and science: the President's National Medal of Science in 1986 and the National Academy of Engineering's Arthur M. Bueche Award in 1990. The former is given annually by the President of the United States to individuals deserving special recognition by reason of their outstanding contributions to knowledge in the physical, biological, mathematical, or engineering sciences. Sol was given the Bueche Award for his "leadership in promoting mutual understanding concerning science and technology among leaders in universities, industry, and government, and for rendering insightful technical advice to five U.S. presidents."

When Sol came to MIT as a graduate student, he joined the plasma dynamics group with William P. Allis and Sanborn Brown. They were applying microwave techniques, which were highly developed during World War II, to the experimental studies of gaseous discharges. Sol did his doctoral work in this area. At the MIT Graduate House, where he lived for a time, he became known as the "expert" on Morse and Feshbach (methods of theoretical physics) problem sets. During this time he began a collaboration with Allis and, later, Abraham Bers, which resulted in the monograph *Waves in Anisotropic Plasmas*, published in 1962.

In 1958 Sol joined AT&T Bell Laboratories as a member of the technical staff, where he continued studies in microwaves and plasmas. That same year the Fusion Energy Program, a worldwide effort, was declassified, and many of the physics issues that faced the program were disclosed. It became clear how little basic plasma processes were understood. Many new researchers were attracted to the field. Sol was very well prepared to tackle some of these fundamental issues, and he was a leader in this period of rapid advance in plasma physics. In his early years he tackled and solved a number of fundamental questions involving plasma heating, guided waves in plasmas, and resonances associated with normal modes. He was elected a fellow of the American Physical Society and served as the chairman of its Plasma Physics Division in 1968. While he did not work on fusion energy research directly, his original contributions to the underlying plasma phenomena and his general expertise and excellent judgment led to his selection as a program adviser early in his career. He remained an effective advocate of fusion energy throughout his professional career.

At Bell Laboratories, Sol also became interested in solid-state plasmas and made original and significant contributions to helicon wave propagation and damping, and Alfven waves in solid-state plasmas. He became the department head for solid-state and plasma physics research in 1961 and director of the Electronics Research Laboratory in 1965. During this early period he published thirty-eight scientific papers of a fundamental nature, many of which were pioneering. He received eight patents for electronic and optical communications devices. He served as associate editor of *Physics of Fluids* (1963–1964), *Journal of Applied Physics* (1968–1970), and *Review of Modern Physics* (1968–1976).

Sol's scientific work was recognized by his election to the National Academy of Engineering (NAE) in 1973 "for his technical contributions and leadership in research on solid-state and gaseous plasmas and their applications." He was also elected to the National Academy of Sciences in 1974 and to the American Academy of Arts and Sciences in 1975.

Sol was appointed to his first advisory post in 1965 as a member of the U.S. Atomic Energy Commission's Standing Committee on Controlled Thermonuclear Fusion Research. His scientific qualifications for this post were the highest, and no doubt the post provided him with an opportunity to hone his skills in technical leadership. Thus began an important aspect of Sol's career: service to the U.S. government. In 1970 he was appointed to President Nixon's Science Advisory Committee (PSAC) when Lee DuBridge was the President's science adviser. PSAC enjoyed tremendous prestige in the technical community. In Sol's words, "The early days were full of promise and we did some good work, but the environment deteriorated rapidly so that effective advice was not possible. . . . partly because some members of PSAC were not in tune with the administration's policies." President Nixon disbanded

PSAC at the beginning of his second term. Sol liked to say that, strictly speaking, he was not fired because he served his term until it came to a natural end.

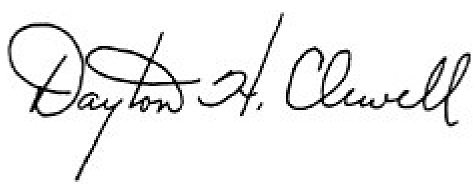
The end of the 1960s had already marked a turning point in Sol's career as he accepted responsibility for larger and more diverse programs at Bell Laboratories. He also became increasingly involved in advising the federal government on a wide variety of its research activities and operations.

In 1968 Sol became vice-president for research at the Sandia Laboratories of the Sandia Corporation, an organization operated by Western Electric for the U.S. government. Sandia was engaged primarily in research and development on ordnance phases of nuclear weapons design, together with a variety of nonweapon projects of national interest. In 1971 he returned to Bell Laboratories as executive director of research, Communications Principles Division, and that same year he was named executive director of research, Communications Sciences Division, where he led one of the largest and finest research efforts in communications sciences and technology in the world.

Sol's responsibilities at AT&T Bell Laboratories continued to grow. In 1976 he became vice-president for network planning and customer services, and in 1979 he became senior vice-president for technology systems, the position he held until his death. In that capacity he was responsible for product realization planning and engineering, government systems, and architectural framework for AT&T products, systems, and services. Altogether he spent thirty-five highly productive years at Bell Laboratories. During that time he supervised projects dealing with fiber-optic communications, digital signal processing, advanced satellites, computers, software, military systems, and high-definition television. In 1987 he received the Institute of Electrical and Electronics Engineers' Frederik Philips Award for outstanding accomplishments in the management of research and development resulting in effective innovation in the electrical and electronics industry.

Buchsbaum's advice on government programs was widely sought. In 1972 he was appointed chairman of the Defense Science Board, serving as chairman until 1976 and as a member until 1980. In 1977 he received the Secretary of Defense Award for Outstanding Public Service. In 1978 he was appointed chairman of the Department of Energy's Energy Research Advisory Board and served as chairman until 1981 and as a member until 1984. In 1981 he received the Secretary of Energy Award for Exceptional Public Service. He was a consultant to the Office of Science and Technology Policy between 1976 and 1982, during the Carter administration. In 1982 he was appointed chairman of the White House Science Council and served until 1989, during the Reagan administration. From 1990 until 1992, he was a member of President Bush's Council of Advisers on Science and Technology. He advised on technical aspects of defense systems, energy systems, and communications systems, and especially on the resource allocation and technical management issues. He also served on boards, too numerous to cite here, of U.S. national laboratories and universities. Sol was a member of the Council of the National Academy of Engineering between 1980 and 1986 and a member of its Executive Committee from 1984 to 1986. He also chaired the NAE's Nominating Committee in 1986 and 1987.

Sol was a very effective participant on each of the boards and committees on which he served. He will be greatly missed by his many friends.


Dayton H. Clewell

DAYTON H. CLEWELL

1912–1992

BY S. L. MEISEL

DAYTON H. CLEWELL, retired senior vice-president for Mobil Oil Corporation's research and engineering portfolio, was born December 15, 1912, in Berwick, Pennsylvania, and died November 11, 1992, in San Gabriel, California.

Elected to the National Academy of Engineering in 1976, Dr. Clewell was recognized for his accomplishments in petroleum research and development as well as his public role as a defender of the energy industry.

Dr. Clewell's career, which spanned an era of great changes in society and in the energy industry, is filled with technological and managerial achievement—from his invention of a gravity meter used for oil prospecting to his general direction of the massive research effort that produced the first commercial zeolite catalyst for the refining industry.

The Great Depression was not easy on young Dayton Clewell's family, but a wealthy philanthropist recognized Dayton's potential and loaned him the money to study at the Massachusetts Institute of Technology (MIT), where his talents in both science and communications took root. He served as managing editor of MIT's newspaper while earning his B.S. in physics in 1933, and as science correspondent to the *Boston Globe* until he obtained his Ph.D. in physics in 1936.

His first job, in optical research for a paint company in Pennsylvania, turned out to be "interesting but not glamorous."

Consequently in 1938 he accepted a research position with Magnolia Petroleum Company (a former affiliate of Mobil) in Dallas, Texas, attracted to the oil business by the romance of prospecting for oil.

By then the nation was experiencing economic rebirth, and facing the prospects of a second global war and a mounting need for fossil fuel energy. While other scientists at Magnolia worked on methods of getting more high-octane gasoline from crude oil, Dr. Clewell built a gravity meter sensitive enough to track changes in the earth's structure, yet rugged enough to use in field work. The company secured a patent on the young physicist's invention, which proved to be useful as a detector of potential oil deposits.

In 1952 Dr. Clewell became director of Magnolia's Field Research Laboratory in Dallas, and in 1956 general manager of Mobil's Research Department, which included both the Field Research Laboratory and the Process and Products Research Laboratory in Paulsboro, New Jersey. In 1964 he was elected senior vice-president for research and engineering, a position he held until his retirement in 1977.

Dr. Clewell directed Mobil's technology efforts during a period of great creativity and achievement by the company's scientists and engineers. To encourage and focus that creativity, he installed a dual-ladder career system to provide greater opportunity for technical people to be recognized and rewarded; established a central research laboratory in Princeton, New Jersey, to work on longer range technology goals; and developed large-project management capabilities within Mobil's engineering organization. These and other strategies paid off handsomely for Mobil and for society.

Under Dr. Clewell's leadership, Mobil researchers developed a number of synthetic zeolites, which have enabled refiners and petrochemical processors to produce more high-value product at less cost. The first was the zeolite cracking catalyst, which when commercialized in 1962 increased the amount of gasoline produced from each barrel of crude oil by as much as 40 percent.

Upstream technologies also advanced as Dr. Clewell's researchers pioneered the application of digital data recording to seismic exploration in the 1960s, greatly improving the ability to "image" potential oil-bearing structures in the earth. And in the 1970s, they were industry leaders in using so-called bright spots on seismic records to pinpoint gas reservoirs in the Gulf of Mexico, and the first to use massive hydraulic fracturing as a means of improving the flow of oil from U.S. reservoirs.

With America's attention beginning to focus on its growing air pollution problems, Dr. Clewell played a key role in establishing and leading an interindustry research program formed in 1967 by Mobil and the Ford Motor Company to reduce automotive emissions. This program demonstrated the interrelationships between fuel composition, engine design, and the catalytic converter—and anticipated much of the emission control technology found on today's automobiles.

In 1973, when the oil embargo dramatically demonstrated to the United States the risks of dependence on Middle East oil, Dr. Clewell directed his researchers to step up their efforts to develop synthetic fuels and energy-conserving products. One result was the commercialization of Mobil 1, the first nationally marketed energy-efficient synthetic motor oil for passenger cars, in early 1976.

Another result was the discovery that one of Mobil's new zeolite catalysts converted methanol, readily made from coal or natural gas, into high-octane gasoline. This was the first new synthetic fuels process since the pioneering work in Germany half a century earlier. Recognizing the potential importance of this breakthrough for that future time when oil would become too scarce or too expensive, Dr. Clewell began development efforts in the mid-1970s that would culminate a decade later in a commercial plant in New Zealand that could convert natural gas to gasoline.

Believing that the nation would sooner or later require alternative energy sources, Dr. Clewell was instrumental in the creation of the Mobil-Tyco Solar Energy Corporation. This corporation was formed in 1975 to develop a method of "growing" thin sheets of silicon crystal, which would be fabricated into solar cells for converting sunlight to electricity. Mobil later obtained 100 percent interest in Mobil-Tyco, renamed the

Mobil Solar Energy Corporation, which is now manufacturing solar panels for utility companies.

In 1976, to ease the shortage of oil in America and Europe, the massive concrete-based Beryl A production platform—designed and constructed under the management of Dr. Clewell's engineers—began producing 100,000 barrels of oil a day in the stormy North Sea. Towed into position a year earlier, the 500-foot-high, 320,000-ton structure was at that time the largest object moved by man and was hailed on both sides of the Atlantic as a technological marvel in terms previously reserved for accomplishments in space.

Meanwhile, Dr. Clewell continued to apply his communication skills, authoring numerous papers and articles—ranging from experimental physics and geophysics to the general subject of managing research. In addition, he was tireless in his endeavors to tell the public about the oil industry's efforts to safeguard and improve the environment while maintaining an abundant supply of energy at reasonable cost.

He gave speeches to public interest groups, appeared on radio and television talk shows, and testified before a number of congressional committees in Washington. The congressional committee members were often hostile toward the energy industry—at one point in the 1970s several hundred bills had been introduced to break the oil companies into smaller pieces. Nevertheless, Dr. Clewell's good humor and objectivity contributed immeasurably to both the legislative and the public understanding of the issues.

In recognition of his technical leadership in areas vital to society, he was appointed in 1971 by President Nixon to a two-year term as a member of the National Advisory Council on Oceans and Atmosphere. He was also a member of the U.S. Navy Oceanographic Advisory Committee, the Marine Petroleum and Minerals Advisory Committee reporting to the secretary of the Department of Commerce, and the Patent Advisory Panel of the U.S. Energy Research and Development Administration.

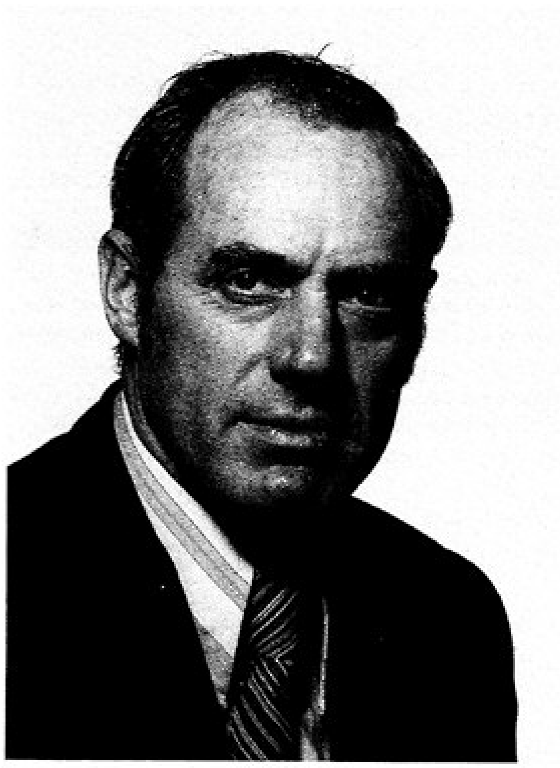
Further, he served as a director of the Coordinating Research Council and the Industrial Research Institute. He also served on New York City's Science and Advisory Council, the American

Petroleum Institute's Committee on Environmental Affairs, and the board of directors of the MIT Corporation.

Dr. Clewell maintained membership in several professional societies, among them the Society of Automotive Engineers, the American Physical Society, the American Association of Petroleum Geologists, and the Society of Exploration Geophysicists. He was also a fellow of the Institute of Electrical and Electronics Engineers.

Dr. Clewell received the Environmental Conservation Distinguished Service Award from the American Institute of Mining, Metallurgical, and Petroleum Engineers in 1974.

Retiring from Mobil in 1977, Dr. Clewell remained involved in the direction of energy research, promoting coordinated efforts to develop a technology base to meet the energy needs of twenty-first century civilization. "It's still such a challenging industry," Dr. Clewell remarked not long after retirement. "There are many technological advances to be made to decrease the risks . . . although it's those very risks that make this business an adventure."



ROBERT L. COBLE

1928–1992

BY MERTON C. FLEMINGS

ROBERT L. COBLE, a leading physical ceramist, died on the island of Maui in Hawaii on August 27, 1992, at the age of sixty-four. Elected to the National Academy of Engineering in March 1978, Robert was a dedicated teacher and researcher widely recognized for his contributions to the theory of sintering of materials and to ceramic processing. He was highly esteemed by students and colleagues alike.

Professor Coble completed his graduate work at the Massachusetts Institute of Technology (MIT) in 1955 and spent the following five years at General Electric Research Laboratories. There he worked on the sintering of ceramics and made major contributions both to the analytical understanding of sintering phenomena and to the applications of this understanding to the development of a completely dense product, "Lucalox." When he returned to MIT in 1960 he had already demonstrated both the scientific capability essential for effective creativity and also the capability for applying this understanding to engineering materials.

Robert rose quickly in the ranks at MIT. He became associate professor in 1962, received tenure in 1966, and was promoted to professor in 1969.

In 1984 he received the prestigious Humboldt Research Award for U.S. Scientists to support a one-year stay in Germany; he spent most of that time at the Max Planck Institute in

Stuttgart. In 1985 he was awarded the Frenkel Prize for outstanding contributions to the theoretical base of sintering materials by the International Institute for the Science of Sintering. He authored more than one hundred technical papers, which have been published in the journals of several disciplines.

He was awarded the National Institute of Ceramic Engineers' Professional Achievement Prize in 1960 and the Raytheon Award for "Outstanding Ceramist of the Year" in 1967. From the American Ceramic Society (ACS) he received the Ross Coffin Purdy Award in 1972 and presented the ACS Sosman Memorial Lecture in 1979 after being nominated for the award by the Basic Science Division of ACS. He was a fellow of the American Ceramic Society and a member of the Ceramic Educational Council and the National Institute of Ceramic Engineers. He served as chairman, vice-chairman, and trustee of the Basic Science Division of the American Ceramic Society and held a succession of offices in the New England Section of the American Ceramic Society. He served on the Defense Advanced Research Projects Agency's Materials Research Council. He served on the advisory board of the U.S. congressional Office of Technology Assessment and on several ad hoc committees organized by the National Materials Advisory Board of the National Research Council, which addressed materials problems.

We are left with the warm memory of an accomplished, dedicated teacher and researcher who contributed much to his field and to his chosen university. We also remember the man himself—a man who spoke and lectured in a relaxed and often informal way—an accomplished sailor and skier. We will long remember his incisiveness and honesty and his friendliness and openness with both his colleagues and his students.

JOHN H. DESSAUER

1905–1993

BY ROBERT J. SPINRAD

JOHN H. DESSAUER, retired officer and director of the Xerox Corporation and the man who brought to a small company the invention that later became xerography, died on August 12, 1993, in Rochester, New York. He was eighty-eight years old.

Dessauer was born in Aschaffenburg, Germany, on May 13, 1905. He earned his B.S. degree in 1926 from the Munich Technical Institute and his M.S. and D. Eng. degrees from the Aachen Technical Institute in 1927 and 1929, respectively. Dr. Dessauer emigrated to the United States in 1929 and went to work for the Agfa-Ansco Corporation in Binghamton, New York. In 1935 he moved to Rochester, New York, to work for the Rectigraph Company, which was later acquired by the Haloid Company. (Haloid changed its name to Haloid Xerox in 1958 and later, in 1961, to Xerox.)

Dr. Dessauer became the head of research at Haloid in 1938. In 1946, as part of an investigation into new technologies, he came across a description of Chester Carlson's electrophoto-graphic process in the April 1945 issue of Kodak's *Monthly Abstract Bulletin*. From this brief twenty-five line abstract, Dessauer immediately sensed the potential for document copying. He described his excitement in his book, *My Years with Xerox: The Billions Nobody Wanted:* "By the time I had finished the abstract I was so excited by its possibilities that I immediately sent it to [Haloid President] Joe Wilson's office."

Ironically, Chester Carlson, the inventor of the process, had taken his ideas to more than twenty companies, including Kodak and IBM. They had all rejected him. Dessauer persuaded the Haloid management to look into it and, in 1947, they successfully negotiated with Battelle Memorial Institute in Columbus, Ohio, for the rights to xerography. In 1959, after many frustrating years, Dessauer's team produced the first successful, fully automatic, plain paper copier, the Xerox 914. Xerox was on its way.

From 1959 to 1968 Dessauer served as an executive vice-president of Xerox. In 1968, after heading Xerox research activities for thirty years, he relinquished that post. However, he continued to serve as a member of the board of directors, a position he had held from 1946 to 1973. He was vice-chairman of the board from 1966 to 1970. He also served on the board of directors of Rank Xerox, Ltd. from 1959 to 1973. Dessauer held many xerographic and photographic patents and was the author of numerous articles. In 1971 he wrote *My Years with Xerox*, recounting his fascinating industrial odyssey.

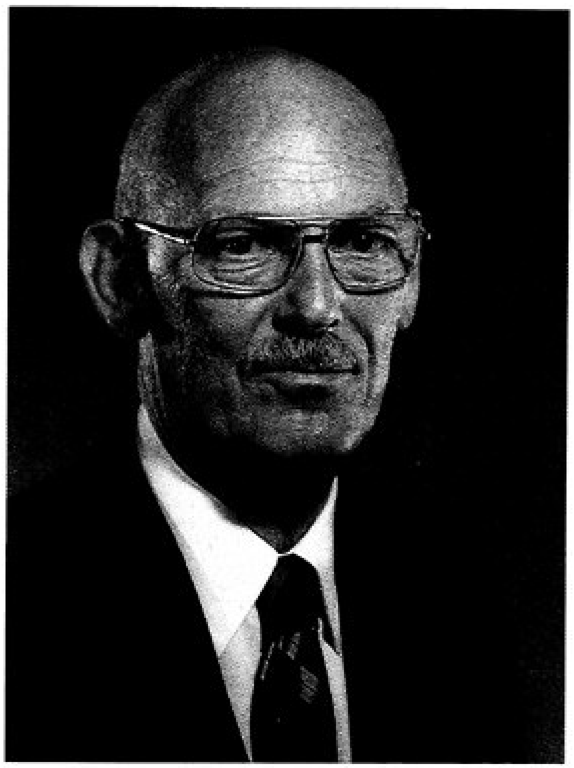
In 1967 Dr. Dessauer was elected to the National Academy of Engineering (NAE). He served on the NAE Council from 1970 to 1976. During his long and constructive career, Dessauer received honorary degrees from Le Moyne College, Clarkson University, and Fordham University, where he also served as a trustee. He was honored by the Industrial Research Institute, which named him its 1968 medalist, and in 1973 he was awarded the Frederik Philips Award from the Institute of Electrical and Electronics Engineers. Dessauer was a fellow of the New York Academy of Sciences, the American Institute of Chemists, and the Photographic Society of America. Most recently, in 1992, he was named honorary member of the Society for Imaging Science and Technology.

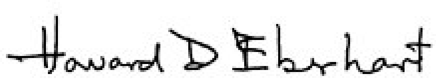
John Dessauer lived up to his reputation as a person committed to social issues. He once said: "I feel a company can be profitable and can meet these [social] responsibilities at the same time. In fact, if management can manage by instilling enthusiasm and mutual respect rather than fear, then a company can be eminently more successful."

Shortly after he retired from Xerox, Dr. Dessauer set up a modest suite of offices for "J. M. D. Associates" in Pittsford, a Rochester suburb. "J" was for John; "M" was for his wife, Margaret; and "Associates" was for his three children. When asked what J. M. D. Associates did, he replied, "It's simply an office devoted to the goal of helping people. It's not a business venture. I'm no longer interested in personal profit. I just want now to devote myself mainly to education and religious and charitable works."

John Dessauer closes his book, *My Years with Xerox*, by observing: "Though the machine has in many ways made man immensely richer, it can also do harm and impoverish him unless he uses it with prudence. This is the challenge that awaits those who follow us. One can only hope that they will meet it with a sense of high responsibility not only to themselves but to all mankind. As new scientific discoveries and new technologies become available at an even faster pace, finding ways of applying them for the welfare of society will be the greatest opportunity that awaits man in the future."

We can only agree—and give thanks that the world was privileged to benefit from John Dessauer's fine mind and good heart.




Howard D Eberhart

HOWARD DAVIS EBERHART

1906–1993

BY BORIS BRESLER, EGOR POPOV, EDWARD WILSON, AND ALEXANDER SCORDELIS

HOWARD EBERHART, one of the University of California at Berkeley's most highly respected and acclaimed teachers in civil engineering, and a pioneer of research in artificial limbs, died of a heart attack on July 18, 1993, while he was returning from Arizona to his home in Santa Barbara.

He was born August 16, 1906, in Lima, Ohio, and attended the University of Oregon in Eugene from 1924 to 1929, graduating with a B.S. degree in architecture. After teaching high school mathematics and science and coaching athletic teams in the state of Washington, he returned in 1933 to Oregon State College in Corvallis, where he received an M.S. degree in civil engineering in 1935. His first appointment at the University of California, Berkeley, was as an instructor in 1936, after which he rose through the professional ranks to become a full professor of civil engineering in 1948. He served twice as chairman of the Department of Civil Engineering from 1959 to 1963 and 1971 to 1974. Throughout his academic career at Berkeley he played a leading role in the growth and development of the Department of Civil Engineering such that the program attained a ranking of first in the nation. After he retired from Berkeley in 1974, he spent three years in Saudi Arabia establishing the Civil Engineering Department at King Abdul Aziz University of Jidda. During the period from 1980 to 1991, he was invited to teach courses in the College of Engineering at the University of California, Santa Barbara.

Professor Eberhart was an outstanding teacher and student adviser and an inspiration to other faculty members. His unique style of teaching made him a particular favorite of students. He received several teaching awards from student organizations at Berkeley and Santa Barbara. Many Berkeley civil engineering alumni, ten, twenty, and thirty years after graduation, have identified him as one of the most important influences on them during their studies at Berkeley. At the memorial service, a plaque dedicated to him stated, "In honor of the memory of a great teacher, who had a major impact on the lives of many Berkeley students, who will always remember him."

Important as his contributions were in teaching and university service, outside the university he was known primarily as one of the leaders in research and development of artificial limbs. Because of his expertise in analytical and experimental studies on many types of structures, he participated in research during World War II aimed at improving concrete runways to withstand the stresses due to heavy bombers. In 1944, during a nighttime test at Hamilton Field in Marin County, California, a heavy truck simulating the weight of a bomber rolled over his leg, requiring amputation below the knee.

The event was a turning point in his life. Striking up a friendship with the surgeon who amputated his leg, Verne Inman, M.D., Ph.D., and professor of orthopedic surgery at the University of California Medical Center in San Francisco (now U.C. San Francisco), he discovered that while prosthetics were generally crafted to the individual, this was done without much thought as to how well they worked as a replacement limb.

As war casualties returned from Europe and the Pacific, the government discovered the same thing, and set up a National Research Council (NRC) Advisory Committee on Artificial Limbs to remedy the situation. In 1945, when the committee approached Dr. Inman to do research on artificial limbs, Inman invited Professor Eberhart to collaborate with him. For the next thirty years they formed a partnership that placed them in the forefront of the national effort in artificial limb research and development.

Together they established in 1945 the Prosthetic Devices Research Project in the Berkeley Department of Engineering under Howard Eberhart's direction. It was sponsored first by the surgeon general of the U.S. Army and later by the Veterans Administration.

This cooperative project between the Department of Engineering in Berkeley and the School of Medicine in San Francisco was unique in that it focused on fundamental studies of engineering mechanics of human locomotion, and on the medical, scientific, and clinical aspects of limb replacement. In this early example of an interdisciplinary project, a team of engineers and surgeons successfully began to lay a foundation in biomechanical principles for the intelligent design of artificial limbs.

In the mid-1950s the research shifted from mechanics of locomotion and design criteria for artificial limbs to clinical studies of the amputees. In 1957 the Prosthetic Devices Research Project became the Biomechanics Laboratory and was moved to the Medical School in San Francisco. In 1967 it returned to Berkeley, and finally ceased to exist in 1974 when the Veterans Administration was not able to support it any longer.

Howard Eberhart directed the project for the first ten years and then continued as one of the faculty investigators first with Verne Inman and later with Chuck Radcliffe. From 1960 to 1966 he served as member-at-large of the National Research Council in the Division of Engineering and Industrial Research, and from 1959 to 1962 he served as the chairman of its Committee on Prosthetic Research and Development. In 1970 he was honored by the NRC at a banquet in Washington, D.C., for his three-year stint as chairman.

In 1977 Howard was elected to membership in the National Academy of Engineering. The citation read: "For pioneering studies of human locomotion, application of structural engineering to prosthetic devices, and leadership of interdisciplinary engineering research."

For almost thirty years Howard Eberhart devoted his professional life to the holistic improvement of prosthetic devices: he was concerned not only with the design of better devices but also with fuller rehabilitation of the amputee. He made sure that the new knowledge was delivered to the field through seminars, workshops, and special publications directed at the artificial limb industry and limb fitting profession. In this he displayed the vision of a great teacher.

Professor Eberhart is survived by his wife, Frances; a sister, Mary Ellen Henderson of Eugene, Oregon; a son, Howard Davis Eberhart II of Concord, California; and two grandsons.

JAMES CORNELIUS ELMS

1916–1993

BY MAX FAGET

JAMES CORNELIUS ELMS IV, a consultant and a retired electronics and aerospace executive, died on May 7, 1993.

Mr. Elms was born in East Orange, New Jersey, May 16, 1916. He received a B.S. degree in physics from the California Institute of Technology in 1948 and an M.A. in physics from the University of California, Los Angeles (UCLA) in 1950.

Jim Elms developed an early interest in aviation and learned to fly as a teenager. He started his career as a stress analyst at Consolidated Aircraft Company of San Diego in 1940, then served in the U.S. Army Air Corps during World War II. As an engineering officer, he developed and patented a simple improvement to the firing mechanism of a machine gun, which improved both reliability and the rate of fire. Subsequently and sequentially he was chief development engineer at G. M. Giannini and Company, Pasadena, California; research associate in geophysics at UCLA; manager of the Armament Systems Department at the Autonetics Division of the North American Aviation Company, Downey, California; assistant chief engineer at Martin Company, Denver, Colorado; executive vice-president of the Crosley Division, AVCO Corporation, Cincinnati, Ohio; and general operations manager of the Aeronautic Division of Ford Motor Company, Newport Beach, California.

In 1963 Jim Elms was recruited into the National Aeronautics and Space Administration (NASA) to become the deputy director of the Manned Spacecraft Center (now Johnson Space Center). This was at a time of the center's most chaotic activity. The Mercury Program was in full operation. Both the Gemini and Apollo were in a period of intense early development and personnel buildup. The population of the center was doubling every half year while being housed in temporary leased quarters scattered throughout Houston. Not incidentally, a sizeable effort was also being devoted to the design of the various technical facilities, which were in various stages of construction at the permanent site for the center, approximately twenty-five miles south of Houston proper. Robert Gilruth, the center director, was in charge of the nation's most prestigious and visible programs. As a consequence he had to concentrate on flight safety and program execution, and he needed help. As might be expected, there were numerous unnecessary conflicts between the major center organizations. Jim Elms, with his working knowledge and experience in numerous and diverse technical organizations, showed up at the right time. Only very minor organizational changes were made—but each organization more clearly understood its role and responsibility and how to work effectively with the others. This was my first contact with Jim Elms, and, as head of the engineering organization, I was amazed at his direct and simple approach to solving interorganizational problems. I soon came to consider him a valued friend whom I admired. I have often sought his advice and counsel.

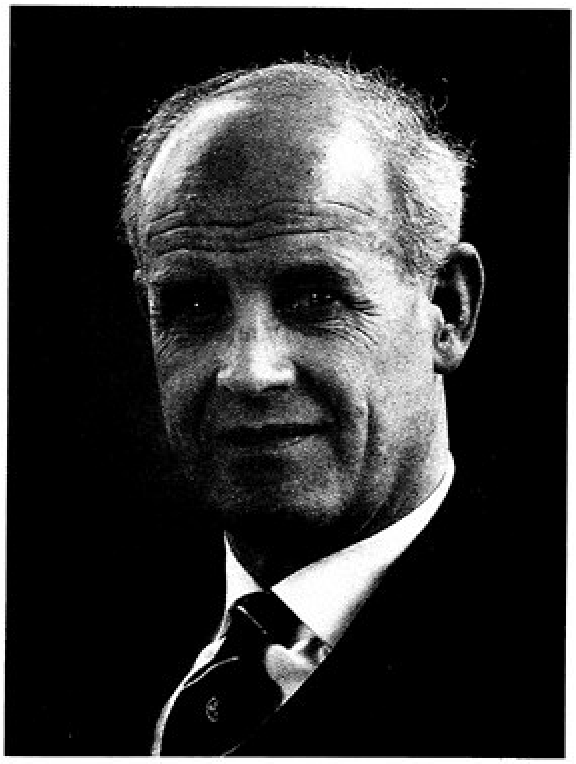
Mr. Elms transferred to NASA Headquarters as deputy to the administrator for manned spaceflight. In 1966 he was appointed director of the NASA Electronic Research Center in Cambridge, Massachusetts. Because of agency budget cutbacks, NASA elected to close the Electronic Research Center. This decision was announced in December 1969, between Christmas and New Year's Day. This was at a time when the center was still growing and was in fact moving into recently completed facilities with further construction being planned. Jim Elms requested and obtained approval to delay the closing until June 30, 1970. He also set in motion various activities to place the center's employees. Most important, he was determined to find another use for the center. This effort culminated on March 25 with the Secretary of Transportation John Volpe's announcement that the facility would be transformed into Department of Transportation offices. The transfer not only saved a number of jobs but also avoided the loss of a national asset. The center is now called the Volpe National Transportation Systems Center and is still serving a vital role for the Department of Transportation.

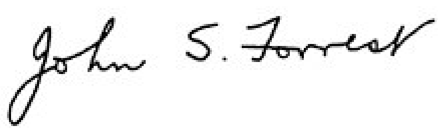
Jim Elms retired from full-time employment in 1974 to become a consultant to aerospace and energy companies. He subsequently became a consultant and adviser to the administrator of the Energy Research and Development Agency, the administrator of NASA, and the director of the Strategic Defense Initiative Organization. He always maintained a keen interest in the national space program and sought every possible opportunity to help NASA improve its programs.

Jim Elms was very proud of the following awards conferred for his service to the U.S. government. He received a NASA special award in 1964, NASA's Exceptional Service Medal in 1969, the NASA Outstanding Leadership Medal in 1970, and the Department of Transportation's Meritorious Service Award, which was presented by the secretary of transportation in 1974.

Mr. Elms was a member of the National Academy of Engineering, a fellow of the Institute of Electrical and Electronics Engineers, a fellow of the American Institute of Aeronautics and Astronautics, a member of the American Physical Society, a member of the Explorers Club, a member of the Air Force Association, and an associate of the California Institute of Technology. He held patents in instrumentation, computers, radar, and mechanisms. He was an avid and proficient glider pilot and skier and was active in both these sports up until his final illness.

Jim Elms was a man of indomitable spirit, and in spite of encountering a series of physical problems or illnesses during his last two decades, he managed to lead a full life. This included participation in his chosen sports and in providing valuable advice and counsel to friends and professional associates. He was fortunate to have a wonderful and loving wife, the former Patricia Pafford, as a partner for more than fifty years. He also took great pride in the four children of their marriage.





JOHN S. FORREST

1907–1992

BY JOHN G. ANDERSON

JOHN S. FORREST, one of the principal leaders in electric power research in Europe and former vice-president of the Royal Society, died on November 11, 1992, at the age of eighty-five. He had been a foreign associate of the National Academy of Engineering since his election in 1979.

His career covered a broad spectrum of creative contributions to the design and performance of high-voltage transmission in Great Britain, development of high-voltage insulation, protection against lightning, enhanced reliability of electricity supply, environmental effects, and leadership in energy research in Great Britain and on the continent of Europe. Founder of the Central Electricity Research Laboratories (CERL) in Leatherhead, England, he led much of the development of the British 275-kV and 400-kV transmission systems, and his work has also been a major influence on energy system development in the Western world.

John was born in Hamilton, Scotland, on August 20, 1907. He graduated from Glasgow University in 1930 with M.A. and B.Sc. degrees in physics, and joined what was then the embryo Central Electricity Board in Glasgow. Within a year he joined the Central Electricity Board in London to take charge of their transmission research activities. He became one of the early pioneers in high-voltage insulation research in Great Britain at that time. From 1931 onward he researched the performance of outdoor insulators on lines and in substations of the British

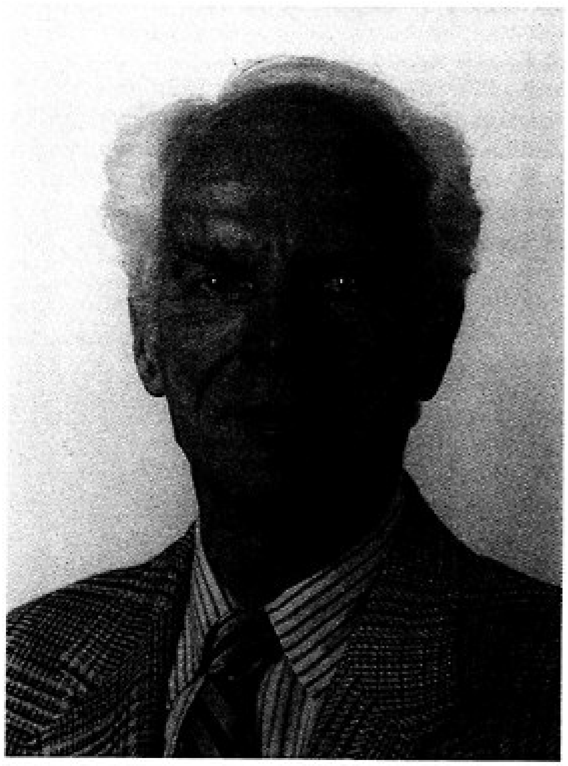
132-kV transmission system, particularly subject to ice, snow, industrial contaminations, and salt storms common in coastal areas. His papers on insulation performance are still standard references today.

The Central Electricity Research Laboratories, founded in 1940, quickly became the principal research arm of the British electric power system and remains one of the leading electrical research laboratories in the Western world. The demands and problems that World War II imposed on the British electrical system, the shortage of staff and materials, and the energy demands for war production all made those early times at the CERL hectic indeed, particularly for John Forrest, its director. Shortly after the war he took time to complete his D.Sc. degree at Glasgow University, while he continued as director of the CERL.

His career from 1931 to 1973 spanned the growth of the British grid from 138-kV to 400-kV transmission capability. Pushing a transmission system into higher voltage levels is always attended by a proliferation of new electrical, mechanical, and environmental problems wherein the cost of poor decisions can be enormous. Often, little experience is available, and high-voltage and high-current research facilities are kept busy breaking new ground, testing new equipment, designing new conductors and hardware, and examining environmental effects. John led this work in Great Britain and was the author or coauthor of approximately eighty-five published technical papers and articles. He was a fellow and vice-president of the Royal Society, secretary of the Electricity Supply Research Council (London), visiting professor of the University of Strathclyde (Glasgow), chairman of the British National Committee of CIGRE (the International Conference on Large High-Voltage Electric Systems), and a fellow of the Institute of Electrical Engineers. He held several patents, including a device to locate distance to thunderstorms, an improved high-voltage insulator design, a method of testing energized line insulators, and a substation protective system.

After forty years of contributions to high-voltage research and service to the supply industry and to electrical power engineering, John Forrest retired from CERL in 1973. However, he continued to contribute to the Royal Society as a vice-president and as an active distinguished lecturer on electricity supply matters and high-voltage physics. He also continued his participation in engineering education at the University of Strathclyde for several years.

John Forrest started his technical and managerial career in the early 1930s when our knowledge of lightning, insulation behavior, and design of electric supply was chaotic at best. When he ended his career in 1992, he left power system engineering a legacy of new concepts and new operational standards and methods that will survive well into the next century. Men like him are rare indeed.



A. PHARO GAGGE

1908–1993

BY HENNING E. VON GIERKE

A. PHARO GAGGE, a world-renowned biophysicist and pioneer investigator of the interaction of varied environments with human body temperature, died at his home at Branford, Connecticut, on February 13, 1993, at the age of eighty-five. His research results and his active involvement in their applications contributed to safety, comfort, and the working efficiency in industrial, military, space, and home environments.

Elected to the National Academy of Engineering in 1979, he was—in research as well as in his government positions—an early supporter of interdisciplinary collaboration in the biophysics and bioengineering areas. He was active to the last days of his life as professor emeritus of Yale University School of Medicine and consultant and fellow emeritus of the John B. Pierce Foundation Laboratory, both at New Haven, Connecticut.

Dr. Gagge was born in Columbus, Ohio, on January 11, 1908. Growing up in Richmond, Virginia, he received his B.A. degree with honors in mathematics and his M.A. in physics at the University of Virginia (1930). After earning his Ph.D. in physics at Yale University in 1933, he joined the John B. Pierce Laboratory, an independent research laboratory affiliated with Yale University and dedicated to exploring the impact of the environment on human health and comfort. His research and teaching activity there started his lifelong career on the reaction of the human body and its temperature regulation to variations in atmospheric conditions, radiation, convection, air movement, and clothing. Joining the U.S. Air Force (USAF) in 1941 he was involved in, and later as head of the Biophysics Branch responsible for, research and development efforts at the Aero Medical Laboratory at Wright-Patterson Air Force Base, Ohio (1941–1950). His work showed that to keep blood oxygen saturation at safe levels when flying at very high altitudes, the oxygen pressure in the lungs had to be increased. In 1941 he performed the first chamber experiment wearing prototype pressure breathing equipment to an altitude of 43,000 feet. This work led to the development of the operational pressure breathing equipment delivered to the combat units in October 1943. Other experiments being conducted with human subjects using the laboratory's all-weather room and refrigerated low-pressure chamber evaluated equipment as well as physiologic effects under climatic stresses such as temperature, wind, humidity, and solar radiation. Leaving the laboratory in 1950, where he served as director of research and acting chief during the last years, he headed the Human Factors Division of the Research and Development Headquarters, USAF, Washington, D.C. (1950–1955) and advanced as colonel to the USAF Office of Scientific Research, serving at the end as its commander (1955–1960). From 1960 to 1963 he served at the Advanced Research Projects Agency, Office of the Secretary of Defense, as program manager in the Cloud Physics, Weather Modification, and Joint Services Electronics Program.

Retiring from the USAF in 1963, he continued his academic career at Yale University School of Medicine as associate professor of physiology and epidemiology, as professor of epidemiology (environmental physiology) (1969–1976), and as professor emeritus from 1976 to 1993. During the same years he was active at Yale University, he was fellow and deputy director of the Pierce Laboratory (1963–1978) and fellow emeritus for the following years.

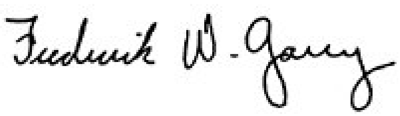
During his almost fifty years of professional activity, Dr. Gagge served on many advisory groups, boards, and committees for the U.S. government, National Research Council (NRC), and technical societies. He served as consultant to the Army/Air Force Scientific Advisory Group under Theodore von

Kármán's directorship (1944–1945); as a member of the Research and Development Board, Coordinating Committee on Medical Research, Human Resources, and Psychological Warfare (1950–1956); as vice-chairman, Governing Board of Bio-Sciences Information Exchange, Smithsonian Institution (1954–1956); as senior resident military representative to the NRC (von Kármán) study at Woods Hole on long-range scientific and technical trends (1957–1958); and as Executive Council member (1965–1968) and chairman (1967–1968), NRC Committee on Hearing, Bioacoustics, and Biomechanics. For the American Physiological Society he was a member of the editorial board (1966–1972), section editor of the *American Journal of Physiology* for environmental physiology and exercise (1972–1976), and associate editor of the *Journal of Applied Physiology* (1977–1984).

Among the awards Dr. Gagge received are the Legion of Merit (1945), the Army Commendation Ribbon (1945), the Oak Leaf Cluster (1960), and the Defense Commendation Ribbon (1963). The Aerospace Medical Association honored him in 1973 with its Eric Liljencrantz Award for basic research into the problems of acceleration, altitude or weightlessness, and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers with its Louise and Bill Holladay Distinguished Fellow Award (1981).

The scientific contributions of Pharo Gagge's long, productive career are documented in over 137 publications and are reflected in many reports, handbooks, and standards. Some of the concepts he introduced are today the standard quantities to characterize human responses to the environment. They include, among others, *Operative Temperature* (combining air and radiant temperature), the *Clo unit* (quantifying clothing insulation), the *Met unit* (quantifying metabolic activity), *Effective Temperature* (quantifying the effects of temperature and humidity on human thermoregulation), and his widely used *Two Node Model* of human thermoregulation and comfort. His activities, results, and advice impacted the field from environmental physiological studies to practical comfort criteria and the engineering of our man-made environments in our homes, in industry, in military, and in space missions.

Active until the end, he led a long productive life of dedication to science and its practical applications to human safety, health, and comfort. All of us who worked with him benefited from his broad knowledge, advice, objective judgment, and contributions. Above all, we enjoyed his friendship, remember Pharo with thanks, and will miss him.



FREDERICK W. GARRY

1921–1993

BY EDWARD E. HOOD, JR.

MY FRIEND AND COLLEAGUE FRED GARRY, who died on February 10, 1993, taught Ted Williams—among scores of others—how to fly, after he himself mastered the art by flying Corsairs and making carrier landings as a marine pilot in World War II.

That was a typical sequence in Fred's long, colorful, and illustrious career. He would achieve a hands-on mastery of the difficult, and then use the experience gained to teach others.

He once recalled a childhood day when—while sitting in an ice cream parlor and listening to the radio news of the Lindberg flight—he looked up at the ceiling fan and envisioned it as a propeller. He said he knew then, vaguely but surely, that he wanted to be a part of aviation. He never forgot that moment or lost the insight it gave him into the importance and evanescence of childhood dreams, and why it is so important that they be nourished and encouraged to eventual fruition. His dream blossomed into a reality of aviation, jet engines, and a lifetime of engineering challenges successfully met.

For someone with a mind of great breadth and complexity, who achieved a perfect 4.0 grade average year after year and innumerable scholastic prizes, Fred was a long-time apostle of simplicity in engineering. A few years ago he told a gathering of department chairmen from forty of the nation's top universities that their "greatest challenge" was to inculcate the importance of "greater simplicity of design" into their students.

At a time when complexity and sophistication were often seen as hallmarks of engineering excellence, Fred understood that simplicity was the key to productivity, and that productivity was the key to America's retention of its embattled status as a world leader in manufacturing. Capable of the most theoretical of explorations, he preferred to fill the role of what his boss, Jack Welch of General Electric (GE), once referred to as a "combat engineer": a hands-on grappler with problems who always saw the marketplace, and sometimes the battlefield, as the ultimate judge of designs.

Fred's career began with General Electric in 1951, and his work quickly centered on a project of urgent national importance—improving the performance of the J-73 jet engine, which at the time had a significant weight and power disadvantage vis-a-vis the Soviet-built MiG in Korean War combat. He made significant contributions to the design of the J-73's after burner and to its jet nozzle development, which restored the advantage to the U.S. Sabre Jet.

Moving up quickly in the engine business, he never removed his hands from the metal. His wife, Betsy, recalls sending him off to work at the Lynn engine works in a brand new and barely affordable suit only to have him return in the evening with it covered with grease, and utterly ruined, after Fred became curious about some component of a jet engine and decided to climb inside it. On another occasion Fred, who had as a marine become accustomed to eating whatever was put in front of him without comment, called her to ask what she was having for dinner that evening. He announced his relief when she mentioned hamburgers because he had spent his entire day firing dead chickens into a jet engine on full power to test its tolerance of bird strikes, and had temporarily lost his appetite for fowl.

After several design assignments of increasing responsibility, Fred became design manager of the J-93 Mach 3.0 power plant and then general manager of military engine engineering for small engines.

GE elected Fred vice-president and general manager of the Technical Division and then, in 1970, head of the Military Engine Division.

Throughout these heavily technical assignments, Fred grew a reputation as a brilliant hands-on engineer, an excellent manager, and a perpetually accessible leader. He played a significant role in the development of the J-79, T-700, CF-700, CF6 and CFM56 power plants, and became one of the "strong men" in GE's Aircraft Engines business—which the company actually contemplated exiting in the 1950s and is now the world leader. Fred was elected to GE's Propulsion Hall of Fame in 1989 and joined a very select group of jet engine pioneers, including "Herman the German"—Gerhard Neuman—who worked with Fred for twenty years. Neuman still remembers the incredible sense of humor Fred had in the darkest hours of seemingly intractable technical problems, a cheerful confidence that Neuman said "made us all winners."

In 1974 Fred left GE to assume the position of president of Rohr Industries and turned that company, by leadership and engineering savvy, into a first-rate manufacturing operation. In 1976 he was named chairman and chief executive officer of Rohr.

But the size and variety of GE always beckoned to Fred, and he returned to the company in 1980. In 1981 he assumed the position of vice-president of corporate engineering, moving easily from medical diagnostic imaging to locomotives to factory automation to appliances—wherever engineering challenges surfaced—and adding a hands-on engineering feel that made seemingly impossible problems evaporate. He was one corporate asset always in demand, always welcome.

Throughout his career Fred shared himself generously with the community. He was a member of the board of managers of his alma mater, the Rose-Hulman Institute of Technology in Terre Haute, Indiana, as well as vice-chairman of the Board of Trustees of Clarkson University in Potsdam, New York. He was a member of the Advisory Committee of the College of Engineering of the University of California, Davis, and a member of the Board of Overseers of the University of California, San Diego. He served three years as a member of the advisory committee to the engineering directorate of the National Science Foundation and was a long-time—and very active—member of the National Academy of Engineering.

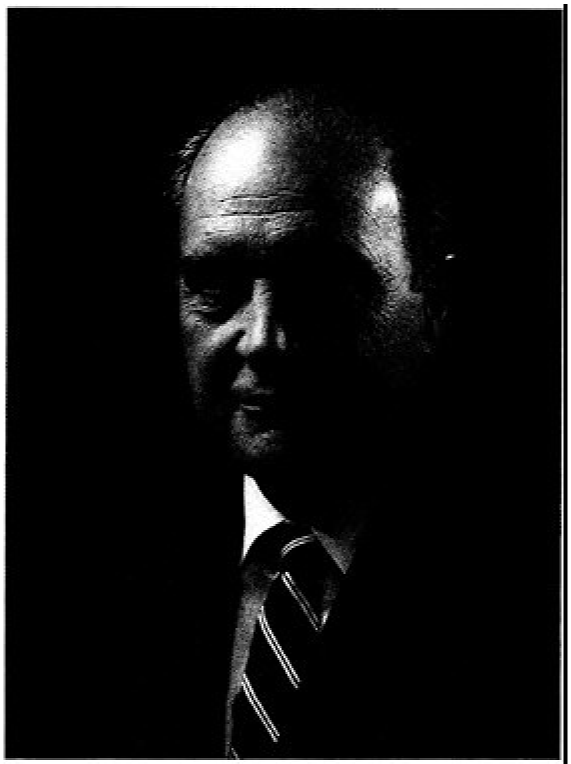
Fred was awarded a commendation by President Gerald Ford for his service to minorities in southern California. He loved to work with young people. While courtly and old-fashioned in many ways toward women, he was a tenacious advocate of expanding opportunities for females in the profession of engineering, and he moved that cause forward at each of the academic institutions with which he was connected.

Fred was a gregarious and friendly fellow. He preferred the employee cafeteria at GE to the officers' dining room and often settled down with his tray at random tables to begin an animated conversation often on engineering or manufacturing, but not always. People who ate lunch with him and talked about movies, which he thoroughly enjoyed, would sometimes get a letter from him in a day or two with his views on the best films of all time by category, neatly ranked. He enjoyed thinking and talking about just about everything regardless of how abstract or romantic, but he always kept one eye on how things worked in the real world.

His beloved wife, the former Honey Griswold, recalls that on the day he proposed, Fred presented her with a ring and a new name, "Betsy." Despite the romance of the moment, his practical side, as usual, showed through. In looking forward to the many decades of marriage that stretched ahead, he had decided that he did not want the rest of the men of the world to address his wife as "Honey." She is Betsy to this day.

Engineering was his other love, and he was one of its "strong men" as well. In 1990 a lifetime of achievement and excellence in the profession earned him a ceremony at the White House and the award by President Bush of the National Medal of Technology "For the design, manufacture and commercialization of high-performance jet engines that lead the world in performance, efficiency, life-cycle cost, and minimal environmental impact; and for his leadership in establishing a technical information exchange and manufacturing alliances assuring the United States global leadership in both commercial and military aircraft engines."

That is an accurate description of one of Fred's many achievements, but it is the humanity, breadth, and accessibility of the man that remain in the hearts and memories of his many friends.



ROBERT F. GILKESON

1917–1993

BY J. L. EVERETT

ROBERT F. GILKESON, engineering pioneer, leading utility executive, and civic leader, died on March 13, 1993, at the age of seventy-five.

Bob Gilkeson joined the Philadelphia Electric Company (PECO) as a cadet engineer after graduating in electrical engineering from Cornell University in 1939. Throughout World War II he served as an officer in the U.S. Army, and then he returned to Philadelphia Electric. In 1951 he was granted a leave of absence to join Westinghouse Electric Corporation, where he participated in the development, construction, and operation of the prototype nuclear propulsion system for the submarine *Nautilus*, the world's first nuclear naval vessel.

Upon returning to PECO in 1953, he was appointed assistant to the superintendent of generating stations, and in 1956 he became superintendent of Eddystone Generating Station, one of the nation's early supercritical steam electric generating stations. The Eddystone Station used steam conditions of 5,000 pounds per square inch and 1,200 degrees Fahrenheit, the highest ever employed commercially. During his years at Eddystone (1956–1960), Bob Gilkeson made significant contributions to the use of very high steam conditions in electric generation.

In 1961 he was elected vice-president of engineering and research at PECO, and in 1962 executive vice-president and a member of the company's board of directors. He was elected president in 1965, president and chief executive officer (CEO) in 1970, and CEO and chairman of the board in 1971. He served as chairman until his retirement in 1982. Even then he continued to serve as chairman of the executive committee until 1988.

Bob Gilkeson guided his company into the use of nuclear energy to generate electricity during his tenure in office. First, PECO participated in the development, design, construction, and operation of Peach Bottom Atomic Power Station's Unit Number 1. This 40-megawatt prototype generating plant used a high-temperature, graphite-moderated, helium-cooled nuclear reactor as its heat source. In the 1960s he oversaw the design, construction, and operation of PECO's first large commercial nuclear generating plant, Peach Bottom Units Numbers 2 and 3. This subsequently led to the construction and operation of a similar large nuclear plant at Limerick, Pennsylvania.

His leadership in the nuclear power field led to his appointment by the governor of Pennsylvania, in 1966, to the state's Advisory Committee on Atomic Development and Radiation Control. In 1968 he founded Radiation Management Corporation (RMC), a medical service organization, which prepared and trained nuclear plant personnel and local hospitals to deal with injuries involving radiation. A quarter century later, RMC is serving utility companies throughout the United States.

Bob Gilkeson's leadership in the U.S. utility industry was recognized by his election as chairman of the Edison Electric Institute in 1977. He also served on the boards of the American Gas Association and the Electric Power Research Institute.

He was elected to the National Academy of Engineering in 1978, and in 1982 was nominated by President Reagan, and confirmed by the U.S. Senate, to the National Science Board, the policymaking body of the National Science Foundation. He was a member of the Institute of Electrical and Electronics Engineers, the National Society of Professional Engineers, the Society of American Military Engineers, and Eta Kappa Nu.

Bob Gilkeson was also dedicated to and active in his community. He served as a trustee of the Philadelphia Port Corporation, a director of the Greater Philadelphia Chamber of Commerce, and a director of the Old Philadelphia Develop ment Corporation. He served as chairman of the Penjerdel Council, covering the regional economic interests of the Delaware Valley. In 1970 he served as general chairman of the United Fund Torch Drive for greater Philadelphia and later as a trustee of the United Way. He served as a trustee of the Penn Mutual Life Insurance Company and as a member of the board of managers of the Germantown Savings Bank. Bob was also active in the affairs of his alma mater, Cornell University, and served as a trustee of the Williamson Free School of Mechanical Trades and the Northern Home for Children.

The Poor Richard Club of Philadelphia presented its gold medal to Mr. Gilkeson in 1976, for his pioneering contributions to nuclear power and for his outstanding civic leadership.

Charles P. Ginsburg

CHARLES P. GINSBURG

1920–1992

WRITTEN BY PETER HAMMAR SUBMITTED BY THE NAE HOME SECRETARY

CHARLES P. GINSBURG, the man who led Ampex Corporation's development of the world's first practical videotape recorder, died at his Eugene, Oregon, home on April 9, 1992. He was seventy-one.

Ginsburg was born in San Francisco and diagnosed with diabetes at the age of four, just two years after insulin was discovered. He lived a normal childhood and graduated from Lowell High School.

Electronics was not his first career choice. He entered the University of California, Berkeley, as a premedical student but transferred to the Davis campus two years later to study animal husbandry. Out of money, he dropped out in 1940 and began work at a series of jobs that eventually steered him into the field where he made his mark sixteen years later.

In 1942 he worked as a sound technician for Harry McCune Sound Services, and from 1943 to 1947 as a studio and transmitter engineer at Associated Broadcasters, Inc., both in San Francisco. It was also during this time that he entered San Jose State College, where he earned a B.A. degree in 1948 in engineering and mathematics. From 1947 to 1952 he worked as a transmitter engineer at Station KQW (now KCBS-AM), San Francisco.

It was there in 1951 that he received a telephone call from Alexander Poniatoff, founder and president of Ampex Cor poration, the small Redwood City, California, company that had introduced professional audiotape to American radio five years earlier. Poniatoff thought Ginsburg could lead a project to create a magnetic tape machine to record television. He was put in charge of a six-member research team that went head-to-head with giants such as RCA and other large electronics companies pursuing the same objective. Ginsburg put together a team consisting of Charles Anderson, Ray Dolby, Shelby Henderson, Alex Maxey, and R. Fred Pfost.

These Ampex engineers found the answer to practical video recording. Instead of "muscling" the tape at high speed past fixed heads, the team used the idea that originally came from Marvin Camras at Armour Research Foundation in Chicago—mounting heads on a rotating wheel that moved the heads rapidly past the slow-moving tape. Starting in 1952 the Ampex team overcame major design obstacles, including head design and wear, head-to-head tracking, and the use of frequency modulated (FM) signal processing. Augmenting the work of Ginsburg and Dolby, the first two team members, were Maxey's mechanical design and his other contributions, Anderson's FM video signal processor, and Pfost's work on recording and playback heads. Their developments included the then-slow tape speed of 15 inches per second (38 cm/s), resulting in a twelve-inch diameter reel of videotape having the amazing recording length of one hour.

A 3M team in St. Paul, Minnesota, under William Wetzel, provided Ampex with the first videotape, a special two-inch-wide tape needed for the new recording technology. This basic formulation was to become the first commercial videotape, Scotch Number 179. By 1956 the prototype transverse scan black-and-white videotape recorder, the Ampex Mark IV, was ready to show to the world.

On Wednesday, November 30, 1956, the nightly CBS newscast, "Douglas Edwards and the News," was recorded at CBS Television City in Hollywood on the Ampex videotape recorder (VTR) for later tape-delayed broadcast to West Coast cities. The fifteen-minute program had been recorded two hours earlier from a network land feed on an Ampex VRX-1000 VTR. The scheduled tape-delayed playback marked the first regularly scheduled broadcast use of the remarkable device. The event would prove one of the most significant technical breakthroughs in the coming global information revolution.

The demonstration of this practical magnetic tape recorder of TV signals was an event of enormous importance to the TV broadcasting industry. The invention made possible instant playback techniques that have become integral to television, reduced production time by many hours, permitted rapid editing, and increased the flexibility in presenting news and other programs. All analog videocasette recorders stem from those first Ampex video recorders. Ampex received an Emmy in 1957 from the Academy of Television Arts and Sciences in recognition of the development of the first practical videotape recorder.

During his time at Ampex, Ginsburg's career track took him from engineer, to senior project engineer, chief engineer, manager of advanced video development, vice-president of video engineering, vice-president of advanced development, and finally to vice-president of advanced technology planning, from which position he retired in 1986.

Ginsburg was elected a member of the National Academy of Engineering in 1973, being cited for invention and pioneering development of video magnetic tape recording for instant playback. Other honors included the David Sarnoff Award for Outstanding Achievement in Radio and Television of the Society of Motion Picture and Television Engineers (SMPTE) in 1957, Vladimir K. Zworykin Award of the Institute of Radio Engineers (1958), Valdemar Poulsen Gold Medal from the Danish Academy of Technical Sciences (1960), Howard N. Potts Medal from the Franklin Institute (1969), Citation from the 6th International Symposium (1969), Master Designer Award from *Product Engineering Magazine* (1969), John Scott Award from the City of Philadelphia Board of Directors of Trusts, Video Achievement Award from the former International Tape/Disc Association (1975), and Citation from the International Television Symposium of Montreux (1975). In 1990 he was inducted into the National Inventors Hall of Fame, where he was credited with leading "one of the most significant technological advances to affect broadcasting and program production since the beginning of television itself."

He served as a member of many video magnetic recording standardization committees, including those of the Society of Motion Picture and Television Engineers, the Acoustical Society of America, and international standardization groups. He served the Society of Motion Picture and Television Engineers as chairman of its Study Group on Digital Television. This group was charged with determining the technical and economic feasibility of the transition to a completely digital operation throughout all of the facilities in a television broadcasting plant, up to the input to the transmitter.

Ginsburg has a number of publications to his credit, including "A New Magnetic Video Recording System," in *Journal of SMPTE*, May 1956, and "Comprehensive Description of the Ampex Video Tape Recorder," in that same journal in April 1957. He received seven U.S. patents and thirty-two foreign patents.

He was a fellow of the Society of Motion Picture and Television Engineers and of the Institute of Electrical and Electronics Engineers. In 1971 he was made a life fellow member of the Franklin Institute of the State of Pennsylvania.

VTR team member Alex Maxey recalls Charles Ginsburg: "Everyone should have the opportunity in life to work for someone like Charlie Ginsburg…. Moreover, they should have such a dear friend … 'warts and all'."

Fred Pfost remembers him this way: "Charlie Ginsburg was a very fortunate person and we were all fortunate to know him and to benefit from his wisdom.

"… [It was] not his technical skills but his innate personality characteristics that allowed him to extract the *finest* from those who were associated with him. He also could smooth the troubled waters that occasionally deluge progress, and he could promote peace in a tribe of prima donnas. We who experienced the early rushes of success in video recording still recall the excitement and pleasure of the achievement and the closeness of our group with Charlie at the helm. May these memories remain with us forever."

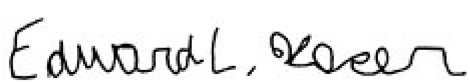
Ray Dolby, whose own breakthroughs in sound technology have since made his name a household word, had this to say of Ginsburg. "Charlie Ginsburg was a people person. I think that was his secret of success in leading the Ampex VTR development team. I met Charlie in the spring of 1952 and was immediately drawn to him. With a ready grin, always a new story and a chuckle, he was irresistible… .

"An aspect of Charlie's interest in and preoccupation with people was that throughout the several years I worked with him, from 1952 to 1957, he tended to see engineering in political terms and struggle. Life was always a competition between the good guys and the bad guys. Like a mother hen, he was always ready to defend his team against the unbelievers and the detractors. Throughout the project, Charlie was brilliant in persuading or cajoling management to provide his team with the wherewithal to do the work. He fought our political battles, and got us the space, the time, and the money. For these things, and for the personal interest he took in all his people, Charlie accumulated a team that was fanatically loyal to him….

"… by [the] sheer force of personality and caring, Charlie earned the affection of everyone who worked for him.

"I will miss Charlie Ginsburg. He was the best boss I ever had."

Ginsburg is survived by his wife, Edna; his five daughters, Jane Ginsburg of San Francisco, Marge Slyter of Sacramento, Nancy Ginsburg Los Altos, Peggy Ginsburg of San Jose, and Patty Lindbeck of Anchorage, Alaska; a sister, Marjorie Morris of Burlingame; and four grandchildren.



EDWARD L. GLASER

1929–1990

PREPARED WITH THE ASSISTANCE OF THE NAE MEMBERSHIP OFFICE SUBMITTEDBY THE NAE HOME SECRETARY

EDWARD L. GLASER, a superb computer systems designer and implementation manager, died December 5, 1990. He possessed a unique overall systems view, which included both hardware and software, and an uncanny ability to lead people in the right direction.

Born on October 7, 1929, in Evanston, Illinois, Ted, as he was known to his family and friends, became totally blind at the age of eight. He faced this misfortune by cultivating a buoyant and witty spirit and a first-class mind. As a boy, he pursued interests in science, mathematics, and music. Year after year he stood at the top of all three fields for his age and grade. As a child, for instance, he became a pianist of virtually concert quality. At the distinguished North Shore Country Day School in Winnetka, Illinois, he established a record as an outstanding student.

In 1951 he graduated Phi Beta Kappa from Dartmouth College with an A.B. degree in physics. Hoping to capitalize on his mathematical abilities, Glaser at first sought work in the actuarial; side of the insurance business. Computers, however, were then just beginning to be produced commercially, and their promise was obvious to a man who, perforce, had to learn to do complex calculations in his head.

In successive connections with various computer firms, Glaser concentrated at first on the hardware aspects—that is, the complex physical circuits and peripheral equipment—of computers. Then he became interested in the computer system as a whole, including the software—compilers, assemblers, languages—and its human users. In pursuit of these interests, Glaser always asked himself how things could be made better and, as a result, held more than fifty patents. Among these were patents for an automatic printer, computer control circuitry, word field selection, magnetic tape, whole data processing systems, stored programs systems, and time-sharing systems. Some of these, of course, were held jointly as Glaser could not see or operate a computer. These inventions were only the tip of the iceberg, however. Many other contributions by Glaser raised the state of the art in the production of the modern computer.

Glaser worked first, from 1951 to 1955, at IBM. In 1955 he became consultant to the director of engineering at Electro Data Corporation, a division of Burroughs Corporation, in Pasadena, California; then in 1960 he became manager of the Systems Research Department of Burroughs in Paoli, Pennsylvania. From 1963 to 1967 he was an associate professor of electrical engineering at the Massachusetts Institute of Technology (MIT), and he then became director of the Andrew R. Jennings Computing Center, and professor of computer engineering and department chairman at Case Western Reserve University (CWRU). From 1975 until 1978 he was manager of the Product Development and Engineering Department at System Development Corporation in Santa Monica, California. He then became vice-president and chief technical officer of the Commercial Products Division, System Development Corporation. From 1979 to 1981 he was director of Advanced Computer Systems Technology, Memory Products Division, Ampex Corporation in El Segundo, California. In 1982 he cofounded—with Ray Sanders—IRI, Inc., in Santa Monica, California, and Glaser became its president. IRI, Inc., was renamed Nucleus International Corporation, and Galser's last position was as cochairman and chief technical officer of Nucleus.

Throughout his career, Glaser always maintained an association with an outstanding university where he had the free dom to think about the information and computing sciences untrammeled by the necessity of short-run payoffs. Thus, while employed by Burroughs in Pasadena, California, he taught computer systems design for the University of California, Los Angeles, extension school in Pasadena. While a valued consultant in industry, he was associated with Project MAC at MIT, helping to establish one of the world's first time-shared computer systems.

At Case Western Reserve University, Glaser wore three hats. He was chairman of the Department of Computing and Information Science, head of the Computer Engineering Division of the School of Engineering, and director of the Jennings Computing Center, which distributed the services of a UNIVAC 1108 campuswide. The center also housed a PDP-10/50 computer for specialized work by the faculty, graduate students, and undergraduate majors in the division and department.

Doing the work of three people, however, was only par for Glaser. It was he who conceived Project LOGOS, the central research program in the information sciences at Case. Project LOGOS was a design project intended to establish and implement the computer-aided design of foolproof, certifiable computer systems that would perform exactly as instructed—no more and no less. No modern, large-scale computer was certifiable in that sense.

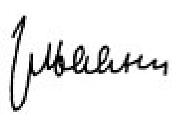
While at CWRU Glaser also conceived the Education Engineering Laboratory. The Olin Foundation agreed to equip that laboratory at a cost of $1 million. The laboratory was intended to establish an experimental instructional laboratory that emphasized the use of electronic and computing equipment; provided competitive, computer-umpired gaming in various fields of business, economics, applied research, defense, space, and diplomatic strategies; and facilitated the production of computer-animated film with sound for use at various educational levels and subject-matter segments.

During the last fifteen years of his life, Glaser concerned himself with the development of hardware and software systems capable of directly storing and processing nonnumerical data. He felt that using numerical computing machines to store and process textual and graphical data was a poor solution. To that end, while at CWRU he designed an innovative data storage and compression scheme, which was sold to System Development Corporation. Later he cofounded his own research and development company, Nucleus International, to bring a revolutionary hardware-based relational database system to market.

Elected a member of the National Academy of Engineering in 1977, Glaser was a fellow of the Institute of Electrical and Electronics Engineers and a member of that organization's committees on Cybernetics, Data Acquisition and Transformation, and Computer Systems. For the Defense Science Board, he was chairman of the Technical Panel of its Committee on Computer Security. He served on the U.S. Air Force's Computer Security Committee; as the computer member of the Department of Transportation's Alexander Committee on Traffic Control; as a trustee of Seeing Eye, Inc., the Sensory Aids Foundation, and the Interuniversity Council; and as a member of the National Academy of Sciences' Division of Engineering, Subcommittee on Sensory Aids of the Committee on Prosthetics Research and Development. He also served on the Science Advisory Board of the National Security Agency.

In 1974 Glaser was named Computer Man of the Year by the Data Processing Management Association and in 1980 received an honorary D.Sc. degree from Heriot-Watt University in Edinburgh, Scotland.

Glaser's friends and colleagues considered him a rare system designer/engineer who understood intimately both hardware and software ideas and exhibited great originality in both. As an engineer he understood great detail without losing an overall perspective of a project's goals. Moreover, he was an excellent judge not only of technical ideas but also of people.



PETER HAASEN

1927–1993

BY ANTHONY KELLY

PETER HAASEN was professor of metal physics at the Georg August University of Göttingen for thirty-four years from 1959. During that time his influence spread worldwide into almost every aspect of the theory and practice of dislocation mechanics. His ideas and the beautiful experiments performed by him and his coworkers affect almost all of materials science/engineering.

Haasen was the exemplar of the great and justly well-known professor, respected and listened to worldwide. He was also a kindly man of great warmth and personal loyalty to all that he took up.

The eldest of four brothers, born to a father who practiced law in Germany, Haasen completed elementary schooling in Gotha (Thüringen) and entered the gymnasium there, leaving in 1944. He was conscripted into the German Wehrmacht and was captured at the end of the war. He has described vividly the steps he took to ensure that he was captured by the Americans.

The breadth and the depth of Haasen's work in applied physics can be appreciated by looking at the issue of *Physica Status Solidi* (a) 131, Number 2, pages 263–736, published in 1992, which contains papers all dedicated to him on the occasion of his sixty-fifth birthday. He developed the field of physical metallurgy, especially in Germany, as a particular scientific discipline. This meant always insisting on a direct explanation based on the concepts of physics and persisting with this however complicated the apparent phenomenon or experimental results. With this approach he advanced materials research across an astonishingly wide field of materials covering metals, semiconductors, superconductors, and ionic crystals. All complex phenomena had to be explained quantitatively in terms of microscopic structures and mechanisms, according to Haasen. Thus, again his work covers an amazing breadth of phenomena: plasticity mechanisms, fiber reinforcement, charging of dislocations, effects of high pressures, internal friction, fracture, and particularly the ductile brittle transition, besides recrystallization, texture formation as well as fatigue in metals and alloys, and the thermodynamics of metastable systems. He was well versed in phase transformation of all kinds and toward the end of his career was still insisting, quite rightly, that there is no coherent explanation of the phenomenon of recrystallization after cold work. He used the most sensitive experimental techniques, such as field ion microscopy, high-resolution electron microscopy, and a battery of physical techniques.

To avoid living under the Russians, in 1945 Haasen's father took the family to Göttingen, where Haasen obtained his Abitur and entered the University of Göttingen. Here he developed a deep love of physics, studying it with mathematics, physical chemistry, and metallurgy. He obtained his diploma in 1951 and in a remarkably short time a Ph.D. for work on crystal plasticity. He was influenced greatly by the accuracy of Richard Becker and the flamboyant and dynamic Günther Leibfried who was then enthusiastically pursuing the theory of dislocations.

After receiving his Ph.D. in 1953 Haasen worked for a year as scientific assistant and then went to the Institute for the Study of Metals of the University of Chicago to work with C. S. Smith and C. S. Barrett. There, under the influence of A. W. Lawson, he showed what a brilliant experimentalist he could be, though his first love was theory, by a series of experiments on the deformation of nickel single crystals at low temperatures and the effect of pressure on their deformation. He discovered a still unexplained upper yield point on reloading metal crystals dubbed by Hans Weertman the "Haasen-Kelly" effect and was the first to investigate the nature of the core of a dislocation in indium antimonide—a III-V semiconductor. These early experiments and his theory of them show how the breadth of his work always carried well outside normal studies of plasticity of single crystals. Haasen chose nickel because it was ferromagnetic, In Sb because it was a compound semiconductor, and pressure as an independent variable because he could study density changes. All of these show the outstanding physicist turning his attention to the complicated problems of metallurgy.

Haasen returned to Germany in 1956 to the Max Planck Institute (MPI) at Stuttgart, where he worked with Werner Köster. At that time he married Barbara Kulp, a student studying mathematics, whom he knew from the University of Stuttgart. She has borne him three beautiful daughters and supported him in all that he has done. At the very early age of thirty-one, Peter Haasen was elected to the Lehrstuhl für Metallphysik u allgemeine Metallkunde (physics of metals and general metallurgy) at the University of Göttingen, succeeding Georg Masing in this position. This was a famous chair of metallurgy, having been previously occupied by Gustav Tannan. Haasen remained in the post until he retired in 1992, though soon after his appointment he changed the department name to metal physics. Due to delay in appointing a successor, he remained in partial charge until 1993.

He built the department almost from scratch, increasing the staff by more than a factor of ten and over the years developing all his interests. Today, at Göttingen, there are individual sections, each headed by a leading professor of metal physics, metallurgy, solid-state theory, and crystal growth. Haasen began by equipping the institute and having a workshop built. With the discovery of hard superconductors in the early 1960s, he moved vigorously into that field. After his visit to Cambridge in 1961, he set up electron microscope investigations of the highest resolving power and introduced field ion microscopy.

These techniques allied with physical measurement enabled him to contribute to the understanding of the early stages of aging of supersaturated alloys and to the development of his ideas on solid solution strengthening. His group's experiments on the deformation of semiconductor crystals soon led to his being recognized as a world expert, particularly on the electrical effects of dislocations in these materials. Because of the breadth of the work he supervised, he was able to generalize the idea of hardening from merely describing mechanical hardness to embracing magnetism and superconductivity.

Haasen personally is to be recognized as an early pioneer of applying the dislocation theory to the mechanical properties of metals. He was one of the first to obtain experimental results on the dynamical formation of slip bands in metals. He established the existence of high-temperature deformation in germanium and other diamond structure materials and carried out a comprehensive set of experiments on the dislocation generation and mobility in ionic solids. He also brought together, in a comprehensive fashion, diverse experimental and theoretical work on the mechanism of solid solution strengthening in metals and in alloys.

Haasen made many visits abroad from Germany: to Cambridge in 1961, to Pennsylvania in 1963 and 1971 (to Carnegie and Mellon in 1963—they were separate institutions then—and to Philadelphia in 1971), to Paris in 1978, and as Schottky Professor to Stanford in 1984 and again in 1988. He visited the Far East on a number of occasions. He learned French in Villefranche in the south of France and was justly proud of his ability in three languages. Through these visits and the use of the Humboldt Foundation and his great industry as a correspondent, Göttingen had many visitors, all of whom remember with affection their visits and the welcome afforded them scientifically and with great good fellowship by Peter and his devoted wife, Barbara.

Haasen was tireless in his support of the profession of metal physics and of modern metallurgy and materials science, the last term is not often used in German. He was a member of the American Physical Society, of the Göttingen Academy of Sciences (president 1981–1983). He was a board member of the German Physical Society of the German Society for Materials Research (chairman 1985–1986); an external member of the

MPI for Metals Research in Stuttgart; and a member of the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME).

He received many international awards, including the Heyn medal of the German Society for Metallurgy (DGM)—now the German Society of Materials—in 1976 and the Robert Franklin Mehl Award of the Metallurgical Society of AIME in 1985. He was elected a foreign associate of the National Academy of Engineering in 1981. He received the Van Horn Distinguished Lectureship of Case Western Reserve University in 1986, the Le Chatelier Grand Medal of the French Society for Metallurgy in 1987, and the German-French Alexander von Humboldt prize for Franco-German cooperation in 1989. Had he lived he would have received the *Acta Metallurgica* Gold Medal in 1994. He was a founding member of the Academia Europea—the European Academy of Arts and Sciences in 1990—being instrumental in introducing materials science as a discipline into that body. He had been elected to the German equivalent, the Leopoldina, in 1986.

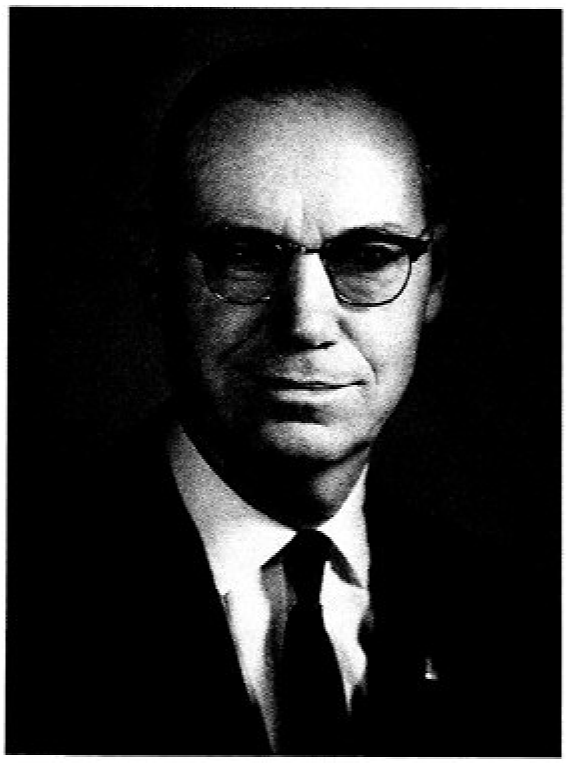
Haasen was particularly concerned to develop cooperation between German scientists and those from lands to the East and from Israel. He was a member of the Technion (Haifa) Board of Governors for many years. He helped a number of Jewish scientists to leave the USSR, as it then was, in order to settle in Israel. He was extremely touched to learn on his deathbed of the award to him of an honorary doctorate by the Technion.

Haasen's contribution to publishing in the field of materials science has been enormous; besides more than 220 publications authored by him and his famous text *Physical Metallurgy,* he was on the editorial board of *Zeitschrift für Metallkunde, Acta Metallurgica, Scripta Metallurgica, Progress in Materials Science, Materials Science and Engineering,* and *Physica Status Solidi*. He was also a general editor with R. W. Cahn and E. J. Kramer of the multivolume comprehensive treatment published by VCH, Materials Science and Technology. He was looking forward to continuing this editorship when he died.

Haasen never left Göttingen although he received many offers; some pressed home with force. He was offered the directorship of the Physikalische Technische Bundesanstalt—the German equivalent of the U.S. National Bureau of Standards, now the National Institute of Standards and Technology (or of the National Physical Laboratory in the United Kingdom)—to succeed Martin Kersten and Ulrich Stille; he was pressed to go to the University of Saarbrücken, but the students at Göttingen persuaded him to stay. As the quintessential dignified professor, the student revolts in 1968 or so deeply upset his moral sense. He was unfortunate in being dean of the faculty of science at Göttingen at the time. He probably would have accepted an appointment as head of department at Stanford, where he and Barbara had much enjoyed their stays, but the German method of employing professors prevented him.

Haasen was a big man physically and in other senses. This combined with his intellect and style of speech to give his statements a certain majesty and to show him to others as a sort of avuncular figure, as he was to many colleagues and friends. These qualities, coupled with a massive integrity, gave him great authority, and all who knew him trusted him implicitly. He was a very devout Christian and an elder member of the university/church organization in Göttingen. He was very kind and his actions showed his great desire to promote friendship between individuals and between nations. Some of the remarks above show how successful he was. His relaxations outside science included taking long walks—often talking about science and music (Mahler and Bruckner were his favorite composers). He acquired compact discs as soon as they emerged.

His loves were physics (of the messy situations of the solid state) and all those people who showed some competence in this area from wherever each might come and not secondly, his family. He was physically very brave and had fought disease—losing an organ, which he revealed to few, some twenty years before his death. He was a great teacher, researcher, and supporter of materials physics. He was very proud of his associateship in the National Academy of Engineering and we, I am sure, are proud of him.



LAWRENCE R. HAFSTAD

1904–1993

WRITTEN BY JOHN D. CAPLAN SUBMITTED BY THE NAE HOME SECRETARY

LAWRENCE R. HAFSTAD, whose five-decade career spanned basic physics research, government service, and industrial research management, died on October 12, 1993, at the age of eighty-nine

During his early career, Larry spent over ten years at the Carnegie Institution of Washington, where his research ranged from studies of the ionosphere to early experiments on light element disintegration.

In the second phase of his career, he devoted fifteen years to government service. These activities started with his work on antiaircraft weapons, proximity fuses for shells, and torpedo exploders for the Office of Scientific Research and Development. Larry then joined the Johns Hopkins Applied Physics Laboratory staff and became its director. Later he served as executive secretary of the Research and Development Board, Department of Defense. His final government assignment was as director of reactor development for the Atomic Energy Commission (AEC).

The next fifteen years of Larry's career were spent in the private sector. He was director of the Atomic Energy Division of the Chase Manhattan Bank for a brief period before becoming vice-president of General Motors Corporation (GM) in charge of corporate research laboratories. He retired from the latter position in May 1969. During this time, Larry continued his Washington interests, especially after 1962 when the GM

Defense Research Laboratories were organized and added to his responsibility.

Born June 18, 1904, in Minneapolis, the son of Norwegian immigrants, Larry worked his way through the University of Minnesota (B.S. in electrical engineering, 1926). Concurrently, he was employed as a maintenance engineer by Northwestern Bell Telephone Company and was elected president of the Minneapolis Inside Maintenance Workers Bargaining Committee. His graduate work in physics began at the University of Minnesota and culminated with a Ph.D. degree from the Johns Hopkins University in 1933.

Larry was, perhaps, best known professionally for his efforts in the peaceful uses of nuclear energy and especially the development of nuclear power plants. Although renowned for these efforts, Larry was particularly proud of three other accomplishments: his work with Merle A. Tuve and O. Dahl leading to the development of a million-volt vacuum tube, for which they received in 1931 the American Association for the Advancement of Science (AAAS) Prize (which became the AAAS Newcomb Cleveland Prize); the development of radio proximity fuses for bombs, rockets, and other military hardware in World War II; and the transformation of the General Motors Research Laboratory from a small automotive development laboratory to a major industrial research laboratory covering a wide range of sciences and technologies.

Larry was elected to the National Academy of Engineering (NAE) in 1968. For his work on military ordnance in World War II, he received the U.S. Navy Medal of Merit and the British King's Medal in Defense of Freedom. He was also a recipient of the Distinguished Service Award from both the Department of Defense (DOD) and the Atomic Energy Commission.

Larry remained active in government service after entering private industry both as a member and chairman of the AEC General Advisory Committee and as a member of the DOD Defense Science Board. He was a member of the NAE Committee on Public Engineering Policy and a member-at-large of the National Research Council (NRC) Division of Engineering. Larry's participation on NRC activities also included the

Executive Committee of the Division of Engineering, the Committee on Undersea Warfare and its Shipbuilding Study Group of the Division of Physical Sciences, the Special Committee on Long-Range Planning of the Highway Research Board, and the Advisory Committee for Study of Non-Rail Transit Vehicles of the Division of Engineering. After his retirement he remained active especially as chairman of the Committee on Undersea Warfare.

Past chairman of the Directors of Industrial Research, Larry also served as a trustee of the Johns Hopkins University, the Carnegie Endowment for International Peace, the MITRE Corporation, and the National Security and Industrial Association. He also served on the Board of Visitors of Tulane University, as chairman of the U.S. Naval Postgraduate School Visiting Committee, and as chairman of the Visiting Committee for Physical Sciences at Johns Hopkins. Larry received honorary awards from his alma mater, the University of Minnesota, the University of Michigan, and Stevens Institute of Technology.

Larry was an early disciple of a systems approach to technical development. He brought much of his enthusiasm for this to General Motors. The range of his eclectic interests continued during the three phases of his career. His thoughtful yet incisive analyses of programs permitted him to contribute to their progress, irrespective of the technical area. A quiet and somewhat reserved mien hid his ongoing interest in the education and development of young scientists and engineers.

Upon retirement Larry and his wife, Mary, and son, Bill, moved from Michigan to the countryside near Chester, Maryland, where they built a new retirement home. Mary predeceased Larry, and he spent his final years living with his son and his son's family in Oldwick, New Jersey.

ALBERT C. HALL

1914–1992

BY LAURENCE J. ADAMS

ALBERT C. HALL, a pioneer in the field of automatic control and servomechanisms, died on September 14, 1992, in Washington, D.C. after a long illness.

Dr. Hall received his B.S. degree from Texas A&M College in 1936. He then went to the Massachusetts Institute of Technology (MIT), where he continued his studies and worked as an instructor in the Electrical Engineering Department. He received his M.S. degree in electrical engineering in 1938 and his Ph.D. degree in electrical engineering in 1943. His doctorate thesis is part of the foundation of automatic control theory.

He continued his stay at MIT as an associate professor. During World War II, as a member of the MIT faculty and research staff, he led the development of the control system for the U.S. Navy's first operational guided missile. After the war, at the request of the navy, he founded and became the first director of the Dynamic Analysis and Control Laboratory, which was dedicated to the development of guided missile control systems. He continued in this activity until 1950 when he joined the Bendix Aviation Corporation as associate director of their research labs.

His creative genius continued to thrive while he was at Bendix. He was responsible for the work that led to the country's first computer-controlled production tool. This tool, a profiling mill, was in operation for many years after its installation at Martin Marietta's Baltimore aerospace factory in 1957. During his years at Bendix he rose to the position of general manager.

In 1958 Dr. Hall left Bendix and joined the Martin Marietta Corporation where he became director of engineering for the Denver Division. Martin Marietta's Denver Division was, at that time, dedicated solely to the accelerated development of the Titan I intercontinental ballistic missile. This was during the so-called missile gap between the United States and the Soviet Union. The technical development of Titan I was successfully completed on schedule under Dr. Hall's leadership. However, he perceived that the tremendous complexity of the cryogenically fueled Titan I would result in very difficult and intensive operational maintenance activity.

Dr. Hall took the lead in proposing a much simplified system using storable propellants, inertial guidance to replace radio guidance, and launch directly from the underground storage silo, thus eliminating the need for the complex elevator system of Titan I.

These improvements and numerous other simplifications were incorporated into a proposed new vehicle named Titan II. He was joined in his campaign for this new configuration by Will Carlson, the senior Ramo Woolridge Corporation manager and technologist assigned to the Titan program. The U.S. Air Force subsequently accepted the idea, and the development of the Titan II system was initiated. This system turned out to be as good as Dr. Hall had projected, and more than one hundred Titan II's remained in the Air Force's operational inventory for more than twenty-five years. They are currently being converted into space launch vehicles, and several have been launched with 100 percent mission success. The Titan family is now up to Titan IV, and the basic core of these giant space launch systems uses essentially the same technology proposed by Dr. Hall in 1959.

Dr. Hall became vice-president of engineering for the Martin Marietta Corporation in 1960 and vice-president, general manager of the Space Systems Division in Baltimore in 1962. In this latter position, he organized and led the corporation's efforts on the Gemini Launch Vehicle, a system that used the basic

Titan II as its key element. This system enjoyed 100 percent mission success on its twelve flights, all manned by National Aeronautics and Space Administration (NASA) astronauts.

In 1963 Dr. Hall departed Martin Marietta for his first tour as a member of the United States government defense technology team as deputy for space technology, Office of the Director, Defense Research and Engineering. In this position, he was instrumental in promoting high reliability and lower cost space systems and launch vehicles for the nation's defense space systems.

In 1965 Dr. Hall returned to Martin Marietta, where he led its engineering and research and development activities. In 1971 he again served in the U.S. Department of Defense, this time as the first assistant secretary of defense for intelligence. Dr. Hall's contributions in this position have gone largely unheralded because of security requirements. However, this period was at the height of the cold war, and acquiring intelligence about the Soviet Union's military activities was of the highest priority. The application of superior technology to the systems of the United States was very ably executed by Dr. Hall.

Upon completion of his tour as assistant secretary of defense in 1976, Dr. Hall returned to the private sector as a consultant in technical management and technology. During this period, he established a close relationship with BDM Corporation and was a close adviser during the corporation's period of rapid growth. He continued as a private consultant through the 1980s when failing health—of first his wife and then himself—required that he curtail his professional activities.

Dr. Hall is the author of numerous technical publications and broad policy statements, which have made strong contributions to our society. His numerous voluntary activities either as a member or as chairman of important government advisory committees multiplied his contributions. He served the Defense Intellegence Agency's Scientific Advisory Committee; numerous Defense Science Board studies, panels, and task forces; and military service advisory groups; and many other important advisory roles.

His contributions have been recognized with numerous honors and awards. They include several from various government agencies and from technical societies.

Dr. Hall will, most assuredly, be remembered for his numerous technical achievements and contributions. He will also be remembered for his friendship and warm sense of humor. However, his absolute sense of integrity is the characteristic for which he stands out. All of his actions were guided by this overriding trait.

W. LINCOLN HAWKINS

1911–1992

BY DAVID W. MCCALL

W. LINCOLN HAWKINS, a leader in the engineering of polymeric materials for long service life, died at his home in San Marcos, California, on August 20, 1992. Hawkins was employed with Bell Telephone Laboratories (now AT&T Bell Laboratories) from 1942 to 1976. He was assistant director of the Chemical Research Laboratory at the time of his retirement. From 1976 to 1983 he was director of research of the Plastics Institute of America and was also active as an independent materials consultant and an expert witness.

Hawkins was born in Washington, D.C., on March 21, 1911. He attended public schools in Washington and was inspired to enter a technical career by a high school teacher, Dr. James Cowen. He persisted in his studies through the difficult years of the 1930s and received a B.S. in chemical engineering from Rensselaer Polytechnic Institute (1932), an M.S. in chemistry from Howard University (1934), and a Ph.D. in chemistry from McGill University in 1938. Hawkins taught at McGill from 1938 to 1941 and was a postdoctoral fellow at Columbia University from 1940 to 1942. His doctoral thesis involved the chemistry of lignin, an important component of wood that must be removed in the making of paper. This work resulted in sixteen publications.

Hawkins's arrival at Bell Labs coincided with the beginning of the age of polymers ("plastics" in vernacular usage, but the field also includes elastomers, thermosets, and other types).

Hawkins was drawn to telecommunications applications of organic materials. He was well aware of a strong prejudice against the use of organics in "quality" products, justifiably based on oxidation and degradation of useful properties. During the 1950s Hawkins and his colleagues made critical contributions to the field of polymer stabilization, which enabled the replacement of lead sheath for cables with polyethylene.

Polyethylene is subject to degradation through photo and thermal oxidation and the tough, flexible polymer becomes brittle and unsuitable to protect the cable. For cable sheath, carbon black is an effective additive to screen out the ultraviolet light that causes photooxidation, but carbon black was antagonistic to the additives used in the 1950s to retard thermal oxidation. Hawkins (and V. L. Lanza) found a thermal antioxidant that performed well (even better) in the presence of carbon black, and this combination was the basis of their patent.

Communications cable is a product that is expensive to produce and install, and basic changes in materials are accepted only after extensive validation of any innovation. Hawkins appreciated the importance of proven integrity and was a prime mover in a program to establish a methodology for accelerated aging based on oxygen uptake. The program was successful and led to widespread acceptance of the Hawkins stabilization package. This is an early example of the use of plastics in a demanding application requiring long service life (forty years!). As a bonus, huge quantities of lead were eliminated from installation.

Beyond these empirical aging tests, Hawkins and his colleagues worked actively on understanding the chemistry of the oxidation process and explaining the surprising synergism of the antioxidant and carbon black. He explored the chemically effective structures for polyolefin stabilization and enriched our knowledge of the basic processes. To an unusual degree he combined the roles of engineer and scientist and made lasting contributions to each field. He taught through the publication of articles in leading journals and through the organization of many symposia on polymer stabilization. Thus, Hawkins was not only a technical creator and practitioner but he communicated the science, engineering, and practice for the improvement of society.

In the mid-1970s the technical community became alert to the finite character of the world's resources. Hawkins, who had been active in the reduction of waste through enhanced durability for more than two decades, turned his attention to the recycling of plastics. Hawkins led an effort that worked out practical procedures for separating and reprocessing factory scrap. He also made substantial advances toward the reuse of plastics from retired apparatus. This problem was of massive proportions, but Hawkins's methods provided tangible results and pointed the way toward necessary research.

Over his career Hawkins published fifty-five technical articles and three books and was issued eighteen U.S. patents.

During his long and fruitful career, Hawkins received many honors and awards. He received the Burton C. Belden Award of the American Chemical Society, the Percy L. Julian Award of the National Organization of Black Chemists, the International Award of the Society of Plastics Engineers, the Honor Scroll of the American Institute of Chemists, and the Achievement Award of the Los Angeles Council of Black Professional Engineers. He received honorary doctorates from Montclair State College, Stevens Institute of Technology, Kean State College, and Howard University. In June of 1992 Hawkins received the National Medal of Technology from President Bush at the White House.

In addition to his outstanding technical accomplishments, Hawkins was enormously effective as a role model and mentor for minority engineers and scientists. Within Bell Laboratories he worked tirelessly on minority education and employment programs and always found time for individual career and personal counseling. With Hawkins's input and advocacy, the Bell Laboratories Summer Research Program for Minorities and Women, founded in 1974, assisted more than 1,200 participants. Hawkins was also active in the founding and operation of the Bell Laboratories Cooperative Research Fellowship Program, which supplies support (monetary and personal) for minority Ph.D. candidates in technical areas. Sixty-six minority engineers and scientists have obtained their Ph.D.'s through this program. Hawkins was the first chairman of the American Chemical Society (ACS) Subcommittee for the Education and Employment of the Disadvantaged (Project SEED). He also served as chairman of the National Academy of Sciences/National Research Council Committee on Minorities in Engineering. In these roles Hawkins had a broad impact on the integration of minority technical contributors into the mainstream of the U.S. technical community. The impact of his effort was national in scope. As the United States faces a future in which engineering and scientific manpower needs will require increased minority participation, his leadership will be ever more appreciated.

Beyond the singular history outlined above, Hawkins was chairman of the North Jersey Section (the largest) of the American Chemical Society and was a national councilor of the ACS for twenty-five years. In addition he found time to hold academic, civic, and church offices in his home state of New Jersey.

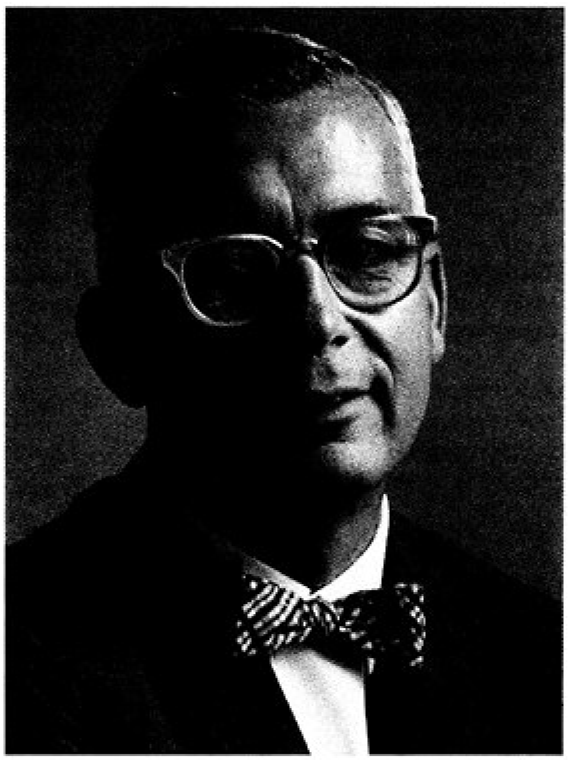
We have recorded above the documented traces, which, however accurate, do not capture the essence of the man. Linc, as he was known to everyone, was extraordinary in many, many ways. His grandfather was a slave who escaped, found his way north with difficulty, became a preacher and then bishop of the Canadian Methodist-Episcopal church, and later toured England and had his history recorded by an Oxford Don.

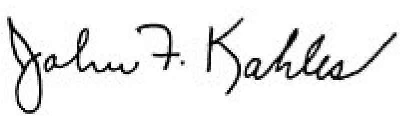
Linc was not notably athletic, but he took great interest in local sports and brought humor to the Bell Labs softball league as an umpire. In the 1950s there was a three-hole golf course on the front lawn of Bell Labs at Murray Hill. One day while strolling after lunch, Linc was attracted by a group of colleagues involved in a hole-in-one contest. Each participant was given two chances. Linc was no golfer and missed entirely with his first swing, but he hit the winning shot on his second, to the amazement of all. He never touched a golf club again.

Linc was always good natured, honest, wise, and friendly. He had a gift for resolving conflict. As an administrator he was kind and firm and got the most people had to give. We never knew anyone who did not like and admire Linc. He was cheerful, the perfect colleague to have on those days that yielded less than we had planned. He loved engineering and chemistry, and his forced retirement from AT&T, under what was then a rigid age rule, was difficult for he was still at the height of his powers and had much to offer. He never complained. He continued to maintain an office at Murray Hill as a consultant on personnel issues, an area in which he continued to make exceedingly valuable contributions. Even so, his technical involvement was lost, which we regretted.

Linc always had a story, never at anyone's expense, to lighten up an occasion. Earlier this year he was being honored by induction into the New Jersey Inventors Hall of Fame. The evening was long, and many speakers possessed of great self-admiration had had abundant access to the microphone. Linc said, "I have only this to remark: 'Behind every successful man there is an amazed mother-in-law.'" Brevity is, indeed, the soul of wit.

It is a matter of ultimate satisfaction that Linc Hawkins, grandson of a slave and educated in segregated schools, stood in the Rose Garden of the White House to receive from the president the highest honor the nation has to offer an engineer.





JOHN F. KAHLES

1914–1993

BY MICHAEL FIELD

JOHN F. KAHLES, retired senior vice-president of Metcut Research Associates Inc., Cincinnati, Ohio, died May 26, 1993. John Kahles was an educator, a metallurgist, an author, a manufacturing engineer, and an industrialist. He played a major role in providing data and information for the manufacturing industry of the United States and the industrial counties of the world.

John was born in Chicago, Illinois, on September 11, 1914. He received a B.S. in chemical engineering from Armour Institute of Technology (now Illinois Institute of Technology) in 1936. He did his graduate work at the University of Cincinnati, where he received a Ph.D. in metallurgical engineering in 1946. During his years at the University of Cincinnati, he was an instructor, assistant professor, and associate professor of metallurgical engineering. In 1951 John joined Metcut Research Associates as a full partner. Metcut Research had been formed in 1948 and was principally involved in metal cutting and machinability research and testing. John had been retained as a consultant to Metcut from its beginning. His earliest efforts were in failure analysis and use of metallurgy in the analysis of machinability and the metal cutting process. A good deal of John's early work was devoted to failure analysis principally in the aircraft industry.

Starting in the 1950s Metcut Research was involved in developing machinability data for a host of new aircraft and aircraft engine components. Much of this work was under sponsorship of the U.S. Air Force Manufacturing Technology Division at Wright Field. Additional efforts were under way to investigate the machinability of cast and wrought ferrous alloys for the automotive and transportation industries. John was instrumental in the investigation of the association of metallurgical structures of these alloys to their machinability characteristics. He demonstrated that the microstructure of cast and wrought steels and alloys directly influenced the cutting performance and with it the economics of the machine tool performance.

John recognized the need for a central machinability data center for industry. He set up such a center at Metcut Research, and in 1964 the U.S. Air Force started to fund the "Air Force Machinability Data Center" at Metcut. This center collected and disseminated machining data and associated information to all contractors and subcontractors in the aeronautic industry doing work for the U.S. Air Force. This data center continued in operation under sponsorship of the U.S. Air Force and the Department of Defense until 1980 and then reverted back to Metcut Research through internal funding.

In 1959 the Army Ordnance Corps put out a request for a machining data handbook, which would provide machining data for every machining operation and for every material and alloy capable of being machined. At the time it seemed to be an impossible task, but under John's direction, Metcut developed the *Machining Data Handbook*, which is now a two-volume set in its third edition and has sold over 70,000 copies. The handbook, of which John was the editor, gives complete machining conditions for over 1,500 metals, alloys, and nonmetallics. It covers eighty machining operations including thirty nontraditional machining processes. One of the major factors making this handbook possible was the classification of the 1,500 work materials into sixty-one categories, each having similar machining characteristics.

An additional accomplishment of John's was the establishment of Metcut's machining seminar entitled *Practical Machining Principles for Shop Application*. This seminar series was started in 1974. About 240 sessions have been given to date, and 8,800 people from industry and academia have attended.

John was also heavily involved in a study of the relations of surfaces generated in the machining process to the mechanical properties of structural components. In 1964 he and his colleague Michael Field coined the term "surface integrity" and applied it to this subject, which has since been used as a quality standard around the world.

John became vice-president of Metcut in 1958 and senior vice-president from 1978 to his retirement in 1990. He was a prolific author and contributor to metallurgical and manufacturing literature. He wrote about one hundred papers. He also was heavily involved in educational and engineering committees and societies at both the local and the national levels. He was a member of Phi Lamba Epsilon, Tau Beta Pi, Sigma Xi, and Alpha Sigma Mu. He was awarded many honors, including the William Hunt Eisenman Award from the American Society of Metals International, Cincinnati Chapter; the Joseph Whitworth Prize from the Institution of Mechanical Engineers, London, England; fellow, American Society for Metals; Engineer of the Year, Technical and Scientific Societies Council of Cincinnati; Distinguished Alumnus Award, University of Cincinnati; and the Research Medal, Society of Manufacturing Engineers. He was elected to the National Academy of Engineering in 1984.

John Kahles was above all a generous and friendly person. He was a strong family-oriented individual. He and his wife, Bea, had seven children and fourteen grandchildren. His house was always filled with his children and innumerable neighbors and friends. He had a 160-acre retreat in Blind River, Canada, where he and his family had vacationed each summer for thirty-five years.

JOSEPH KESTIN

1913–1993

BY DANIEL C. DRUCKER

JOSEPH KESTIN, professor of engineering at Brown University, died on March 16, 1993, of acute leukemia. Founder and first director of the university's Center for Energy Studies, he continued his high level of activity and productivity in research until the very end. Throughout his long and distinguished academic career, in which both experimental and theoretical research played so important a role, Professor Kestin was a superb teacher of undergraduate students. They, along with the host of other readers of his texts on thermodynamics, appreciated greatly his fundamental and challenging approach to the understanding as well as the use of thermodynamic principles.

Born on September 18, 1913, in Warsaw, Poland, Professor Kestin received his Dipl. Ing. degree from the Technical University there in 1937 and then began graduate study at Kings College, London. Soon after his return to Warsaw for a visit in late summer 1939, he was sent to a Russian prisoner-of-war camp and was not released to serve with the Allies until 1941. He was then able to resume his graduate studies at Imperial College, London, and completed his doctoral thesis on "High Speed Flow of Gases Through Channels" under the direction of Sir Owen Saunders.

Following World War II the Polish University College, as a transient arrangement to permit the many expatriate Poles to complete their education, became a unit of the University of

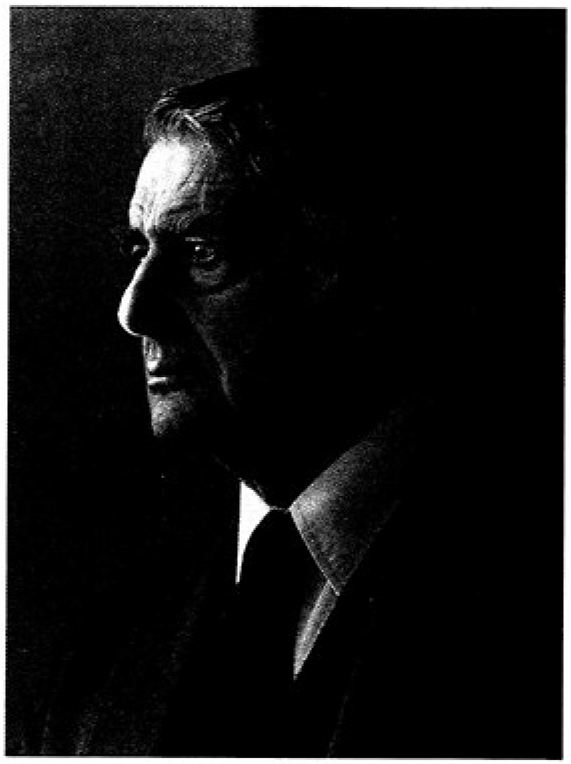
London with Professor Kestin as the head of its Department of Mechanical Engineering. In 1952 he came to the United States to begin his long and fruitful association with Brown University.

Professor Kestin's many awards and honors predate and postdate his election to the National Academy of Engineering (NAE) in 1982. He was a recipient of the James Harry Potter Gold Medal of the American Society of Mechanical Engineers (ASME) for his contributions to thermodynamics, a D.Sc. from the University of London for his eminent research contributions; the Water Arbitration Prize of the Institution of Mechanical Engineers, London; an Alexander von Humboldt-Stiftung Senior U.S. Scientist Award; a Fulbright Lecturer of the Technical University of Lisbon; and an honorary doctorate from Claude Bernard University in Lyon, France. In addition he was elected a foreign member of the Polish Academy of Sciences, a fellow of the Institute for Advanced Study in Berlin, and a fellow of Imperial College. He served as visiting professor at a number of universities in the United States as well as at the University of Paris at Sorbonne, the Claude Bernard University, Imperial College, the universities of Stuttgart and Bochum in Germany, the Norwegian Technical University in Trondheim, the Technical University in Lisbon, and the University of the Armed Forces in Munich.

As appropriate in each situation, he taught courses and delivered many keynote lectures at national and international conferences in French or German or in elegant and impeccable, slightly British, English. Joseph and his wife, Alicja, maintained their fluency in their native language by often speaking Polish at home.

Professor Kestin's publications number well over 250, including five books on thermodynamics. They include seminal contributions to the thermodynamics of inelastic solids as well as fluids. He also translated into English important texts by E. Schmidt, A. Sommerfeld, and H. Schlichting to bring their work into the mainstream of our thinking.

Professor Kestin served the engineering profession in a variety of other ways. In collaboration with many colleagues from this country and abroad, he developed the oscillating-body viscometer into the remarkably precise tool required for the accurate measurement of the properties of steam and other fluids of great industrial importance. This led to his positions as the chief U.S. delegate to and then president of the International Association for the Properties of Steam. He served as one of two coeditors of the *ASME Journal of Applied Mechanics* for fifteen years, as a member of the Executive Committee and chair of the Applied Mechanics Division of ASME, and as a member of the Peer Committee for Mechanical Engineering of the NAE. He also served on numerous editorial boards, advisory boards, and panels of the Department of Energy, National Science Foundation, National Bureau of Standards, and National Research Council as well as a number of other groups. In recognition of his broad contributions to the field of energy, Professor Kestin received a special citation from the governor of Rhode Island.



EDWIN HERBERT LAND

1909–1991

WRITTEN BY STANLEY H. MERVIS SUBMITTED BY THE NAE HOME SECRETARY

EDWIN HERBERT LAND—inventor, scientist, entrepreneur, teacher, visionary, and public servant—was born in Bridge-port, Connecticut, on May 7, 1909, and died in Cambridge, Massachusetts, on March 1, 1991, at the age of eighty-one. He was educated at the Norwich Academy and Harvard University.

While still a freshman at Harvard, Land was intrigued with the natural phenomena of polarized light and was challenged simultaneously by the difficulty of using it in science and the impossibility of using it in applied science for industry because the then-available light polarizers were Nicol prisms, large single crystals, heavy, expensive, and necessarily limited in size. There were no "sheet" polarizers. Land conceived the idea of making in sheet form the optical equivalent of a large, single crystal by suspending submicroscopic polarizing particles in plastic or glass and orienting these polarizing particles in a transparent sheet. Following a leave of absence to pursue his ideas, he returned to Harvard bringing with him his new light polarizer. In 1932 at a Harvard physics colloquium he announced a "new polarizer for light in the form of an extensive synthetic sheet," a polarizer known as "J-sheet." He later took another leave of absence to devote himself entirely to research in polarized light. Although he never graduated, Land returned to Harvard on many occasions as a lecturer, and to receive an honorary doctor of science degree in 1957.

During World War II Land invented the "H-sheet" light polarizer made by staining oriented polyvinyl alcohol with iodine. H-sheet is still the most widely-used light polarizer.

The light polarizers Land invented made it economically possible to make use of the phenomenon of light polarization in products as diverse as camera filters, scientific instruments, train and airplane windows, three-dimensional movies, and polarizing sunglasses. His dream of an automobile headlight system using polarizers to prevent blinding glare from on-coming vehicles while increasing visibility for the driver never became a reality, although all the scientific and technological problems involved were fully solved.

During World War II, Land turned Polaroid to military research and production. A number of inventions contributed to the war effort, including infrared light polarizers; dark adaptation goggles; variable density goggles; polarizing ring sights, which had no optics and no restriction on aperture or exit pupil; and Vectograph three-dimensional light-polarizing images uniquely suited for aerial reconnaissance.

"Din" Land is a unique example of the success of the American Patent System in carrying out its constitutional charter "to promote the Progress of Science and Useful Arts." The limited exclusive rights given for Land's inventions permitted him to organize Polaroid Corporation to exploit his light polarizer, and permitted Polaroid to grow and to support the research and development necessary to bring succeeding inventions to the marketplace. He filed his first patent application in 1929 and received 537 U.S. patents during his life, a total exceeded by only a few others. Land actively participated in the preparation of his patent applications and often suggested unconventional ways to define his inventions.

Land is perhaps most widely known for the Land instant photographic process, invented in the mid-1940s, stimulated by his three-year old daughter's question, "Why can't I see the picture now?" This photographic process was first publicly demonstrated on February 21, 1947, at a meeting of the Optical Society of America. In that talk he outlined the theoretical considerations involved in designing one-step systems and broadly described the entire field of instant "one-step" photography. His concept of developing the film immediately after exposure in a hand-held camera, employing only a single "dry" step, was made practical by making the processing reagent viscous and enclosing the viscous reagent in a single-use, rupturable container called a "pod." That invention was protected by U.S. Patent Number 2,543,181, issued February 27, 1951, the patent cited when Land was inducted into the National Inventors Hall of Fame in 1977. The entire photographic industry found the pod to be a uniquely valuable instrument, which remains fundamental to all instant films.

Full-color instant prints were introduced by Polaroid in 1963. In 1972 Land described his system of "absolute one-step photography" in which full-color images develop outside the camera, a system embodied in the Polaroid SX-70 camera and film. A "chemical darkroom" provided by pH-sensitive opacifying dyes replaced the mechanical darkroom embodied in the earlier one-step cameras.

Land subsequently developed the Polavision instant movie system, a major technological achievement, which was unsuccessful in the marketplace. The technology, however, became the basis for Polachrome instant 35-mm slides.

Land's work in optics and color led him to experiments that showed inconsistencies in classical concepts of color vision. These experiments led him to construct his Retinex theory of color vision, in which it is not the relative amount of red, green, and blue light coming to the eye that determines color, but rather the formation in the retina and the cortex of an image in apparent lightnesses on three or more wavebands and a comparison at each point in this image of the three or more independent lightnesses that determines the color.

Land was elected a member of the National Academy of Engineering in 1965 and was awarded its Founders Award in 1972.

Land advocated continuing education for everyone in industry and in the professions. He established generous tuition refund programs to encourage employees to gain new capabilities. He instituted in-house educational and training programs, which became so extensive that Polaroid was called the third largest educational institution in Cambridge, surpassed only by Harvard and the Massachusetts Institute of Technology (MIT). Believing that college students should gain first-hand research experience, he regularly brought them into Polaroid for summer jobs. Land was a visiting Institute professor of physics at MIT and served as a member of the Harvard University Board of Overseers Visiting Committee for physics, astronomy, and chemistry.

Land served the federal government in a number of capacities, including membership in the President's Science Advisory Committee and in the President's Foreign Intelligence Advisory Board for many years. He has been given major credit for the development of the U-2 high-altitude reconnaissance airplane. He received the Presidential Medal of Freedom in 1963, the National Medal of Science in 1967, and the National Medal of Technology in 1988. Land was a past president of the American Academy of Arts and Sciences and a former trustee of the Ford Foundation. He was a member of the National Academy of Sciences and the National Academy of Engineering.

As a member of the Carnegie Commission on Educational TV in 1966–1967, Land's testimony before Congress has been cited as having played a pivotal role in the creation of the present American system of public broadcasting.

He received fifteen honorary doctorate degrees and was a fellow, honorary fellow, or honorary member in numerous scientific and engineering societies. He received medals from numerous scientific organizations, including the Franklin Institute, the Royal Photographic Society, the American Society of Mechanical Engineers, the Optical Society of America, and the Society of Photographic Scientists and Engineers.

Polaroid Corporation was organized in 1937 as a successor to Land-Wheelwright Laboratories, with Land as president, director of research, and chairman of the board. He continued as president until 1975, as director of research until 1980, and as chairman until 1982. He took pride in having established a company that provided wonderful products for its customers and also had as a corporate aim an environment that provided a satisfying and rewarding work life for its employees.

A video tribute to Land, presented at the 1991 annual meeting of Polaroid stockholders, included the following Land quotations, which give an insight into his philosophy:

> Any problem can be solved with the materials available in the room at the time.
>
> Science is a technique to keep yourself from kidding yourself.
>
> Keep your options open, baby. Don't say *yes*; don't say *no*; if you can, say *maybe*.
>
> Anything worth doing is worth doing to excess.
>
> Every creative act is a sudden cessation of stupidity.

While cognizant of the importance of the stock market, Land's disdain for Wall Street's growing obsession with profits per se in the 1970s was evidenced by his answer to a reporter's question about Polaroid's "bottom line": "The bottom line is in heaven."

Land founded the Rowland Institute for Science, a nonprofit basic research laboratory, in 1980 and served as its president and director of research until his death.

Land was survived by his wife of sixty-one years, Helen Maislen Land, and two daughters, Jennifer and Valerie.

INGE MARTIN LYSE

1898–1990

BY LYNN S. BEEDLE

INGE LYSE was a world leader and pioneer in concrete research and its application to practice and in the organization of groups to accomplish those activities. He was born in Lysebotn in southwest Norway on October 22, 1898. He graduated from the Norwegian Institute of Technology (NTH) in Trondheim in 1923, and there he later received his doctor *technologie* degree in 1937.

In the year of his birth, reinforced concrete was practically unknown. Within his lifetime it was to become one of the predominant structural materials throughout the world, no small part of that due to Inge Lyse.

It was adversity that led him to the United States. Those early days are described best in his own words:

> Soon after my graduation from NTH in June 1923 I put in an application for immigration to the USA as there were no jobs available in Norway at that time. A few months later I received my permission and in November I left for Los Angles where I had an uncle who was optimistic about engineering jobs there. I called on the construction division of the Southern California Edison Company for a job. After three or four months I was informed that they had an opening for me as a chairman at the Florence Lake Dam construction. I accepted the job and left immediately for Big Creek.
>
> By the end of 1925 the construction work was nearly completed, so the engineering staff was drastically reduced. The engineer in charge asked if I would be interested in joining an engineering group for the

> construction and experimentation of the Stevenson Creek Experimental Arch Dam, which was to be constructed a few miles below Big Creek.
>
> Naturally, I accepted this offer and became a member of the eight-man staff which would assist Professor Willis A. Slater from the U.S. Bureau of Standards, who was in charge of this important research work.
>
> The Engineering Foundation sponsored the project. For a special theoretical analysis of the results, Professor H. M. Westergaard was called from the University of Illinois during the summer of 1927. He was Danish and we spent much time together.
>
> I was the only foreigner on the staff and it was therefore very strange that Slater selected me to become his personal assistant. He also had me coordinate the work of the staff at the Los Angeles office, both for the experimental results and the preparation of the final report.
>
> As our report approached completion, Slater told me that he had written to his friend, Professor F. R. McMillan who had recently taken over as director of research at the PCA [Portland Cement Association] laboratory in Chicago after Duff Abrams, the originator of the water-cement ratio law, and recommended me for a research position. McMillan offered me a job as his personal assistant, and I accepted immediately and came to Chicago in August 1927.
>
> As the major work of the column investigation at Lehigh University was nearing its completion by the summer of 1931, Professor Slater asked me to fill out an application blank for a position at Lehigh University. The Depression was at that time rather serious, especially for private universities, but Slater hoped that President C. R. Richards would find a solution. And soon after the budget meeting of the Board of Trustees I received my appointment to the Lehigh University faculty from August 1931.

Lyse recognized the importance of personal relationships. Again in his own words,

> The fact that Lehigh University was located in Bethlehem, Pennsylvania, where the Bethlehem Steel Company has its headquarters, and furthermore that the Fritz Engineering Laboratory was a gift to the university by one of the officials of the company, made it natural that the research work should include structural steel as well as concrete. In fact Dr. Richards, president of Lehigh University, advised me especially of this at the time I became responsible for the laboratory upon the death of Professor Slater in October 1931.
>
> Contacts with Jonathan Jones, chief structural engineer of the Bethlehem Steel Company, led to a very good relationship. But at one of our first open house arrangements at the laboratory, we were just in the midst of testing some large reinforced brick columns when President Richards brought with him Dr. Eugene Grace, the mighty president of

> the Steel Company who at that time also was the president of the Lehigh University Board of Trustees. It was therefore necessary to show them that we actually laid great weight on the studies of structural steel sections in torsion, which were carried out on a soap bubble model basis, and direct torsion tests of regular steel sections as well as other structural steel investigations. President Richards expressed later that this maneuver proved very successful.

In 1938 his own country and his own alma mater called upon him to take the chair of professor of reinforced concrete, which he held until retirement thirty years later.

Lyse served as the UNESCO expert at the Indian Institute of Technology from 1951 to 1953. As a member of UNESCO's mission, he established its teaching schedules and curricula. He was the UNESCO representative on the study of higher technical education in the USSR in 1955, UNESCO expert regarding technical education in Venezuela in 1960, UNESCO chief technical adviser to Pakistan from 1961 to 1962, and Norwegian representative to Uganda, Kenya, and Tanzania in 1965.

Lyse's honors and awards are impressive:

- Louis E. Levy Medal of the Franklin Institute, 1937
- J. James R. Croes Medal of the American Society of Civil Engineers, 1937
- honorary member of the American Concrete Institute, 1962
- Award of Outstanding Professional Achievement of the Norwegian Society of Professional Engineers, 1965
- Knight of the Royal Norwegian Order of St. Olav, 1966
- honorary member of RILEM (International Union of Testing and Research Laboratories of Materials), 1971
- honorary member of the Norwegian Academy of Technical Sciences, 1974
- honorary member of the Norwegian Concrete Association (founded on Lyse's initiative), 1980
- foreign associate of the National Academy of Engineering, 1981
- honorary doctor of engineering, Lehigh University, 1981

In addition he became a member of the American Concrete Institute (ACI) in 1926, was elected a member of the

Board of Direction of the ACI for the term 1937–1939, and was appointed a member of the Division of Engineering and Industrial Research of the National Research Council, 1937–1940. In 1938 he was elected president of the Lehigh University Branch of Sigma Xi.

Bruce Johnston (who was Lyse's student and who took over from him at Fritz Lab) once wrote: "In addition to his scientific skill, Professor Lyse holds a rare ability to spot the practical problems and to initiate and organize professional work to solve these problems…."

Deming Lewis, in presenting Lyse to the Lehigh faculty for the honorary doctorate of engineering, described his influential leadership in the following way:

> Because of his work in establishing and maintaining international cooperation among engineers, it can be said that there is no nation in the world which has not benefitted from Professor Lyse's knowledge. Indeed, few large buildings and bridges built anywhere in the world have not been influenced in design and construction by the work that he has done.

A perspective of Lyse's pioneering work is perhaps best summed up by Rolf Lenschow, one his former students.

> Lyse has in several fields executed a work of a pioneering nature. This work pertains to the durability of concrete in its various conditions. Typical of Professor Lyse is that he has not only carried through important research on concrete in sea water, but carried the work on to practical rules and regulations on how to produce a concrete best fitted to fulfill the requirements revealed by research.
>
> In the construction of the enormous structures on the Continental Shelf, the shrinkage and creep of concrete acquires a dominating influence. The research work of Professor Lyse is of significant importance in that field today.
>
> Lyse's analytical and experimental studies of reinforced concrete columns should be mentioned. The simple method that he and his associates arrived at is considered classic and is being used by designers the world over.

He was most important in the early development of Fritz Laboratory at Lehigh—but even more so in what he taught to the graduate students: How to conduct research … how to write … how to create a sense of community. He started the Fritz Engineering Research Society in 1935, an informal group of graduate students and faculty, which is approaching its sixtieth year with over 600 members. His own perspective of what he had done in this and other ways was the following:

> My years at Lehigh University were in many ways the most pleasant and gratifying of my life. At the Fritz Laboratory we all became one great family—the research staff, and graduate students and the laboratory staff. And after leaving Lehigh in 1938, it was a great pleasure to learn that my two most promising graduates, Bruce Johnston at Columbia University and Hank Godfrey at Roebling Steel Wire company, were appointed to take over after me.

The impact of all of this on the students who came under his influence is typified by the remarks of Knud E. Knudsen, a Norwegian who received his Ph.D. at Lehigh working under Bruce Johnston's leadership, who returned to Norway to become a leader there:

> As a young student I did not fully understand the luck in studying under an internationally renowned expert, except that in my reading of the prominent professional publications I ran across references to his work by the simple identification "Inge Lyse" in italics. There seemed to be no need to add titles or affiliations to his name. Later, in my years of travelling, I found that doors to universities, laboratories, and institutions opened freely to the simple statement that I was a student of Inge Lyse.
>
> Professors are not only scientists and teachers—they are also human beings in close contact with a new generation at its most searching and decisive period of life.
>
> When all this has been said, however, I venture that a professor's personal and human characteristics outweigh those in the technical arena in their impact upon a student's aptitudes, attitudes, and ambitions.
>
> The inspiration and challenge to professional curiosity that Inge Lyse has always shed upon his surroundings in and out of the university has made a good engineer of many a mediocre student by promoting interest and awakening hidden reserves, and has even produced inheritors of his professional excellence.
>
> Inge Lyse taught us that the intellectual grindstone upon which to sharpen one's wit is of less importance than the process of learning—

that the particular field of study is predominately a means of acquiring the methodology and habit of learning.

In response to testimonials at the time of his eightieth birthday, Lyse's remarks included both his personal side and his professional side. In them he shares with us his sense of amazement at the career opportunities that came his way:

> I have always been wondering about how I happened to become connected with research work in the USA. I had no other education than that from the NTH. I had attended no school, seminar, or advanced courses after leaving Norway. I had, therefore, no qualification for any type of research work. How could then the chief engineer at Big Creek select me as the only one of his big engineering staff for the research group at the Stevenson Creek Dam, and why did Slater select me as the only foreigner on his staff to become more or less his personal assistant? That Slater and Westergaard recommended me to McMillan at the PCA may not be so strange, but why did McMillan create for me the position at his personal assistant? I knew very little English at my arrival in the USA and learned it mostly from the rather rude construction crew at the Big Creek.
>
> At Chicago the report writing became an important part of my work and here McMillan's personal secretary gave me some important training when writing and rewriting my drafts. And McMillan himself took everything with good humor when going through my manuscripts. At Lehigh I again had Slater with his patience, thoughtfulness, and great correctness. He was actually like a father to me from the day I met him in Big Creek in January 1926 until his death in 1931.
>
> Upon Slater's death, Dr. Richards told me that I should take charge of all duties at Fritz Laboratory. I had to guide the graduate students in their theoretical and experimental work and give the graduate courses required by the curriculum as well as handle all research and experimental work of the laboratory, including commercial industrial problems. Why should such major responsibilities be given to such a young person?

The answer to Lyse's question? He was a man of unusual ability. A man of warmth. A man not afraid to respond to new opportunities. A man of vision. A man of dedication to this people, his superiors, and his colleagues.

The world has lost a true leader. But in a real sense, the structures around us will keep us perpetually aware of his greatness.

HERBERT G. MACPHERSON

1911–1993

BY A. M. WEINBERG

HERBERT G. "MAC" MACPHERSON died suddenly in Guadalajara, Mexico, on January 26, 1993, at the age of eighty-one. Thus passed one of the most highly respected pioneers of nuclear energy.

MacPherson's scientific career began at the University of California, Berkeley, where he received the bachelor's degree in 1932 and the Ph.D. degree in physics in 1937. While at Berkeley he was much influenced by Professors R. B. Brode and Leonard Loeb. His first scientific paper (1934), of which he was the sole author, described a definitive experimental refutation of the so-called F. Allison magneto-optical method of chemical analysis. In this first paper MacPherson already displayed qualities of scientific common sense and impeccable responsibility that were the hallmarks of his entire career, both as a physicist and as an engineer. During this early period MacPherson worked on cosmic rays with Brode and M. A. Starr, and during a short stay at the Weather Bureau, he analyzed the accuracy of the Smithsonian Institution's measurements of the solar constant.

In 1937 when MacPherson joined the National Carbon Division of the Carbide and Carbon Chemicals Company, physicists in industrial companies were rare; indeed MacPherson was the first physicist hired by National Carbon. His first job was to investigate by sophisticated spectrophotometric methods, the properties of the carbon arc. Since the carbon arc was the light source used in professional motion-picture projectors, many of MacPherson's papers at this time were published in the *Journal of the Society of Motion Picture Engineers*.

The discovery of fission in 1939 launched MacPherson on his major lifework—nuclear energy, and particularly the role of graphite in nuclear reactors. MacPherson, in a talk he gave many years after fission was discovered, recounts his earliest involvement with graphite: "My first knowledge of the possible use of graphite to aid in sustaining a nuclear chain reaction came from reading an article [by R. B. Roberts and J. B. H. Kuiper] in the September 1939 issue of the *Journal of Applied Physics*. This article aroused speculation within the National Carbon Company about the role for graphite [in nuclear chain reactions]." By 1940 MacPherson met with Fermi, Szilard, and H. Anderson to discuss procurement of ton-lots of graphite of a purity that had never been produced commercially. MacPherson, with his knowledge of the spectra emitted by carbon arcs, was the first to realize that boron was the most significant impurity, because of both its high neutron absorption and its ubiquity in graphite. He, along with V. C. Hamister, developed a way of producing almost boron-free graphite on the scale needed for the huge graphite-moderated reactors at Oak Ridge and Hanford. This was described in the 1958 book *Production and Properties of Graphite for Reactors*, by L. M. Currie, V. C. Hamister, and H. G. MacPherson. Had it not been for MacPherson and Hamister's success in producing boron-free graphite, the plutonium-producing reactors at Hanford would not have chain-reacted. (This contrasts with the German rejection of graphite as a moderator because they had overestimated the absorption cross-section of carbon—presumably because German graphite was contaminated with boron).

MacPherson maintained his contact with nuclear energy by spending the year 1946–1947 attending the first sessions of the newly established Oak Ridge School of Reactor Technology (then known as the Clinch College of Nuclear Knowledge). Many of nuclear energy's most prominent engineers, including H. G. Rickover, attended these courses. I first met Mac as a student in my lectures on chain reactor theory; I quickly realized that he was the best student in the class.

MacPherson continued to work on graphite at National Carbon, serving as assistant director of research from 1950 to 1956. He then joined the Oak Ridge National Laboratory (ORNL), where he became the leading proponent of molten fluoride-fuelled, graphite-moderated reactors. Such reactors theoretically showed great promise as a cheap alternative to the mainline plutonium-fuelled liquid-metal-cooled fast breeder (LMFBR). Because the fuel in molten fluoride reactors was a liquid, chemical recycle to remove fission products was much simpler than the recycling of solid fuel elements, such as are used in the LMFBR. The promise of molten-fluoride breeders was recognized by the Atomic Energy Commission (AEC) in its 1962 report on civilian power; molten-salt breeders, based on thorium-U^{233} cycle, were given a priority equal to that of the LMFBR in this report.

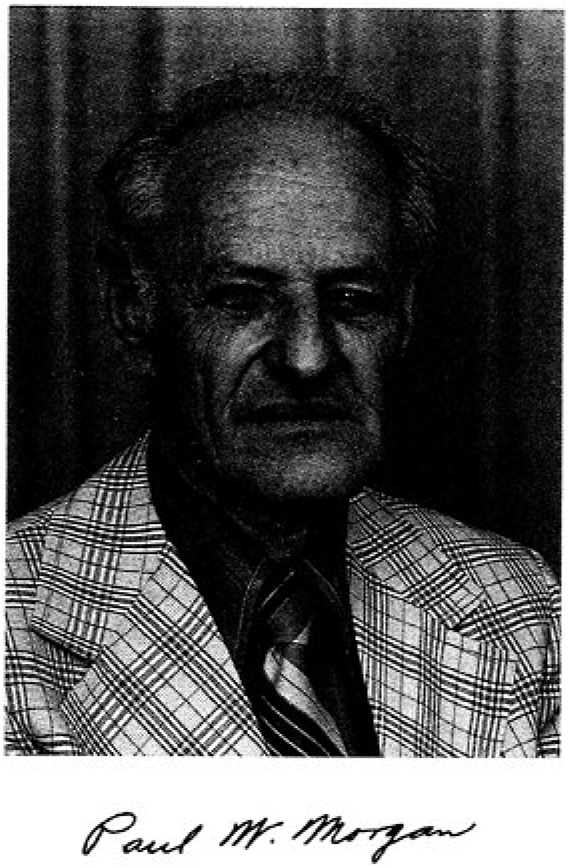
During all of his fourteen years at ORNL, the last six years of which he served as the deputy director of the laboratory, MacPherson continued to be the intellectual force behind the molten-salt reactor. His ideas culminated in the very successful Molten Salt Reactor Experiment (MSRE). This reactor, operating at 7500 kW and 1200°F, consisted of a graphite cylinder through which circulated a molten fluoride salt containing U^{235} and Th^{232}. The MSRE operated remarkably well for three years beginning in 1966. During 1969 it operated with U^{233} as fuel, the first nuclear reactor to be fuelled with this isotope of uranium. The MSRE was perhaps the most ingenious and daring engineering experiment ever conducted at ORNL. But, largely for nontechnical reasons, molten-salt graphite-moderated reactors were eventually dropped by the AEC in favor of the LMFBR.

Mac himself, although he took this loss of support philosophically, left ORNL in 1970 to become professor of nuclear engineering at the University of Tennessee (UT). In December of 1973, with support from the White House's Federal Energy Office, I undertook to establish the Institute for Energy Analysis (IEA); but before I could start the institute, I was called to Washington to head the Office of Energy Research and Development (OERD). Fortunately Mac agreed to take leave from UT to serve as acting director of IEA. Upon him fell the onerous task of getting a completely new energy think tank going—everything from hiring the staff, guiding the program, and commuting to the White House each week to offer advice to OERD on national policy for energy research and development. This was the time of the first oil crisis, and energy policy was on center stage. Mac's common sense as well as sheer intellect contributed in innumerable ways toward setting our energy research policy on a sensible course.

I returned to direct IEA in 1975, but Mac remained as the wisest member of the staff, as well as continuing to teach nuclear engineering until 1976. Mac was a sort of in-house conscience for IEA. For example, he served as a member of the advisory committee that reviewed the IEA study *The Second Nuclear Era*, published in 1985. This study examined "inherently safe reactors" as a technical basis for a reborn nuclear energy. Mac's intellectual honesty was demonstrated by his arguing that the water-moderated PIUS (Process Inherent Ultimately Safe) reactor was more nearly inherently safe than was the high-temperature, graphite reactor despite the latter's being based on graphite, the material around which his technical life had been centered.

Mac finally "retired" in 1985—to become an expert in Mayan archeology. He learned how to read Mayan glyphs and even published a paper, "The Maya Lunar Season," in the 1987 volume of the British journal *Antiquity* . In this paper Mac resolved a logical inconsistency that had plagued students of the Dresden Codex "eclipse table." In the prior archeological literature the dates in the Dresden Codex were identified with occurrences of solar eclipses worldwide. Mac realized this could not be correct since most solar eclipses were not visible to the Maya. Instead, he demonstrated, by astronomical calculations, that the dates mentioned in the Dresden Codex coincided with the transit of the moon at sunset from north of the setting sun to south of the sun. These transits, he argued, were well within the observational capability of the Mayan astronomers.

Thus, even to the end of his life Mac displayed the independence of thought, confidence in his own judgment, and plain common sense that characterized his life. In my obituary at Mac's funeral, I referred to him as a "Prince of a Man." Mac was one of the most highly respected scientist/engineers to have worked at ORNL. He led an exemplary, fulfilled life—and his passing leaves a deep sense of loss in his many admirers who appreciated his unusual qualities of judgment and wisdom.



PAUL W. MORGAN

1911–1992

WRITTEN BY GERARD LAVIN, JOE T. RIVERS, JOHN R. SCHAEFGEN, AND STEPHANIEL. KWOLEK SUBMITTED BY THE NAE HOME SECRETARY

PAUL WAS KNOWN by his colleagues as a consummate experimentalist. Through his pioneering work in polymer synthesis he created synthetic methods, which led to new classes of polymers, which have touched the lives of most of us. At the same time, he remained true to the hardy values of his Maine upbringing, and to the end of his life he delighted in sharing his learnings with others.

Paul Winthrop Morgan was born on August 30, 1911, in West Chesterfield, New Hampshire. He spent most of his youth in Thomaston, Maine, a place to which he returned frequently throughout his lifetime. He obtained his B.S. in chemistry from the College of Technology of the University of Maine in 1937 and started work on his Ph.D. in organic chemistry at the Ohio State University. His studies were interrupted from time to time by the need to earn money to pay for his education. While working in a store in Thomaston he met his future bride, Elsie Bridges. They were married in 1939. He earned his Ph.D. in 1940 and remained at Ohio State as the DuPont postdoctoral fellow in cellulose chemistry until 1941, when he joined E. I. DuPont de Nemours and Company in Buffalo, New York.

The two outstanding accomplishments of Paul Morgan's work were the laying of a synthetic foundation for the development of a host of advanced materials, and the provision of synthetic methods and well-characterized polymers, which stimulated scientific research worldwide, especially in the area of extended-chain liquid crystalline polymers. He made it easy for students and teachers to make condensation polymers; his nylon rope trick is one of the most popular and effective demonstrations available in the classroom. Condensation polymers became as accessible as vinyl polymers for the research scientist in academia; the nonequilibrium nature of the polycondensation reaction made many novel linear, branched, and cross-linked polymers, and block and graft type copolymers of predetermined structure available for scientific study. The whole new field of extended-chain liquid crystalline polymers was opened. The very fact that he made many heretofore intractable polymers and processed them to valuable new advanced materials, e.g., Kevlar aramid fiber, inspired industrial scientists worldwide to invent and synthesize many new advanced materials, such as polycarbonates, polyarylates, polyimides, and thermoplastic elastomers for fibers, films, engineering resins, and polymers for electrical and electronic applications. His contributions to synthetic polymer chemistry and their impact on materials science have been compared to Ziegler-Natta polyolefin synthesis in importance and potential. Writing in *High Polymers* (Japan) in 1973, K. Tsubol describes Morgan's interfacial methods and their application to synthetic fibers as an "epoch-making discovery." The late Paul Flory, Nobel laureate in chemistry, wrote of Morgan in 1975: "His discovery and development of the interfacial method of low temperature condensation polymerization stands out as one of the most important achievements in synthetic polymer chemistry of the past quarter century…. It is becoming increasingly clear that Morgan has opened up a domain of polymer science (his work on stiff-chain liquid crystalline polymers such as para-aramids) of vast importance that may be surpassed only by stereospecific polymerization…. In brief, Paul Morgan's research is characterized by an extraordinary degree of originality. He has advanced both fundamental polymer chemistry and technological development, the two in concert to a degree scarcely to be found in the work of any scientist since Wallace

H. Carothers…. Dr. Morgan's contributions in either of the two major fields cited above are sufficient to merit the highest recognition. In combination, they are superlative."

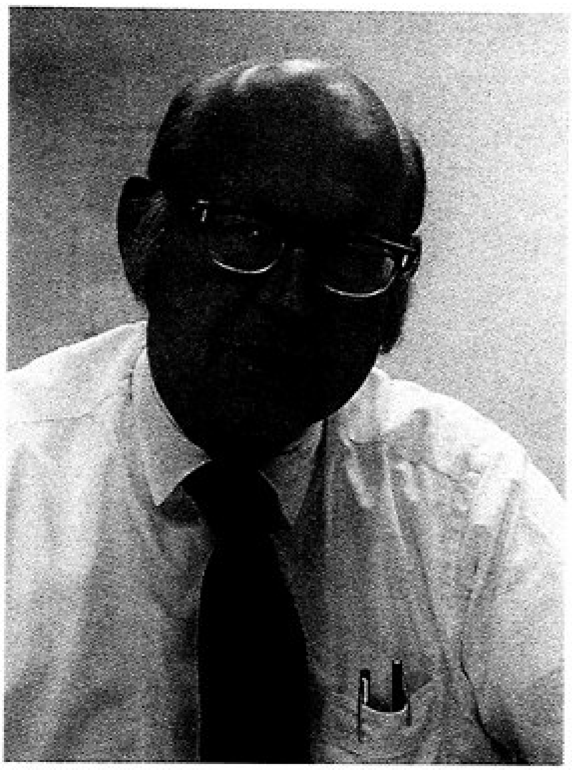
Paul's published work includes thirty-eight U.S. patents, fifty-six articles, and a book, *Condensation Polymers by Interfacial and Solution Methods*. He was honored by many awards, which included DuPont's Lavoisier Medal, the American Chemical Society Award in Polymer Chemistry, the Howard N. Potts Medal of the Franklin Institute, the Engineering Materials Achievement Award of the American Society for Metals (awarded to DuPont), the Swinburne Award of the Plastics and Rubber Institute of Great Britain, the Thomas Midgley Award for contributions to the automobile industry from the Detroit Section of the American Chemical Society, and the University of Delaware Composites Institute Medal of Excellence in Composites. He was elected to the National Academy of Engineering in 1977.

The list of organizations to which Paul belonged included the Sierra Club, the Appalachian Trail Conference, the Wilderness Society, the National Audubon Society, the National Wildlife Federation, the Chester County Historical Society, the Early American Industries Association, the National Fiber Society, and the National Academy of Engineering. Apart from his career as a scientist, his principal activity was a lifelong interest in the Boy Scouts of America. As a youth and young man in Maine during the 1920s, he held all positions of junior leadership and served two years as an assistant scoutmaster. As a young father in West Chester, Pennsylvania, in 1954 he resumed his Scouting career by helping to organize a neighborhood Cub pack. He successively became troop committeeman, assistant district commissioner for Cub Scouting, assistant scoutmaster, brotherhood member, and adult adviser in the Order of the Arrow. His Scouting awards included the Scouter's Training Award, Scouter's Key as Commissioner, District Order of Merit, and the Wood Badge Award (this is the Scouting Ph.D.). He helped establish an Explorer post at the DuPont Company and helped establish the Brandywine Battlefield Medal Trail—leading men and Scouts of Troop 43 in clearing and marking trails. Over the years he acted as a merit badge councillor and examiner for numerous subjects. Perhaps his greatest reward in Scouting was organizing and leading yearly back country camping trips to Baxter State Park in Maine. These were very demanding excursions with the objective of learning advanced survival skills. This led Paul to become an authority on edible wild plants, an interest that he pursued with his usual thoroughness and that he shared with his Scouts. In 1967 the Scouting community recognized his achievements with one of its highest awards, the Silver Beaver.

Along the way Paul resumed a youthful interest in mineralogy. With characteristic intensity he hunted for rocks wherever he vacationed, became a member and ultimately vice-president of the Mineralogical Society of Pennsylvania, and built an extensive, carefully catalogued personal collection. His daughter, Mrs. William Harding, donated the collection to West Chester University, where it has been integrated into the university's geological museum.

Another of Paul's interests was the history and collection of tools. He specialized in the development of saw sets. His ambition was to have a specimen of every commercial saw set that had been manufactured in the United States, and he came very close to achieving this goal. He set and sharpened the tools himself and he collected patent literature. From his father, who was a shipwright, Paul inherited many skills and a very practical collection of relevant tools—large wood bits with massive crossbar handles, large chisels, adzes, saws, clamps, etc. He built up the tool collection by judicious addition through his lifetime.

Paul Morgan died at age eighty on May 28, 1992, following a lengthy illness. He will be remembered for his willingness and skill to teach colleagues, friends, and neighbors of all ages the many things he had learned and for imparting in some measure his joy in scholarship.



ALLEN NEWELL

1927–1992

BY EDWARD A. FEIGENBAUM

ALLEN NEWELL, a pioneering computer scientist with broad ranging contributions to information science and technology, died on July 19, 1992, at the age of sixty-five. Newell is considered one of the founders of the field of artificial intelligence, and was a major scientific figure in the field of cognitive psychology.

Newell was elected to the National Academy of Engineering in 1980 and the National Academy of Sciences in 1972. His scientific career was distinguished not only by deep insights and remarkable innovation but also by his concern with creating and nurturing institutions suitable for furthering the growth of computer science. He was a founder of the Carnegie Mellon Computer Science Department—now one of the world's major departments; he was a founder of the American Association for Artificial Intelligence and was its first president. He was also president of the Cognitive Science Society. Over the years he served as adviser to the major government funding agencies for computer science, psychology, and health sciences research.

Newell received his B.S. in physics from Stanford University in 1949 and his Ph.D. in industrial administration from Carnegie Mellon University (CMU) in 1957.

Newell was involved with computing almost from the beginning of the computer era. he began his career at the Rand Corporation, helping to start their Systems Research Laboratory for studying behavior of air defense teams. Newell was responsible for programming simulated air defense environments on the primitive computers of the early 1950s. He would later win a major award of the Human Factors Society for this pioneering work.

In the mid-1950s, Newell's scientific attention was captured by the idea of the digital computer as an adaptive mechanism—indeed the possibility of the computer as a cognitive mechanism. His paper on an adaptive chess playing program was quickly followed by a collaboration with J. C. Shaw of Rand and Herbert A. Simon of Carnegie Mellon University.

Rand transferred Newell to Pittsburgh to work with Simon, and in December of 1955 the two of them conceived, and then in a creative burst programmed, the first heuristic problem solving program, Logic Theorist (LT), which proved theorems in propositional calculus. This is the landmark program usually thought of as the birth of artificial intelligence, though the field did not pick up that term until the Dartmouth conference in the summer of 1956.

The method of programming LT was itself a landmark of programming technique: Information Processing Language (IPL). A series of IPLs from 1956 to 1959 introduced list processing, recursive programming, stacks, generators, and many other pieces of the art of programming that we take for granted today.

These language innovations were used to program the influential Newell-Shaw-Simon chess player, and the very influential General Problem Solver (GPS) that set the paradigm for work in artificial intelligence for almost a decade.

After several years as a Rand staff member in Pittsburgh, Newell joined the faculty of CMU in 1961, and later became the U. A. and Helen Whitaker University Professor of Computer Science. He published more than 250 works, including ten books. His most recent book, *Unified Theories of Cognition*, published by Harvard University in 1990, brings to the public Newell's renowned William James Lectures (1987).

In Newell's last lecture to his CMU students and colleagues in December 1991, he characterized his career as "desires and diversions." His main desire was the quest for an understanding of mind—mechanistic models of mental processes so detailed that precise predictions of human behavior could be made and tested. A secondary desire was the engineering of computational artifacts that were capable of significant cognitive behaviors.

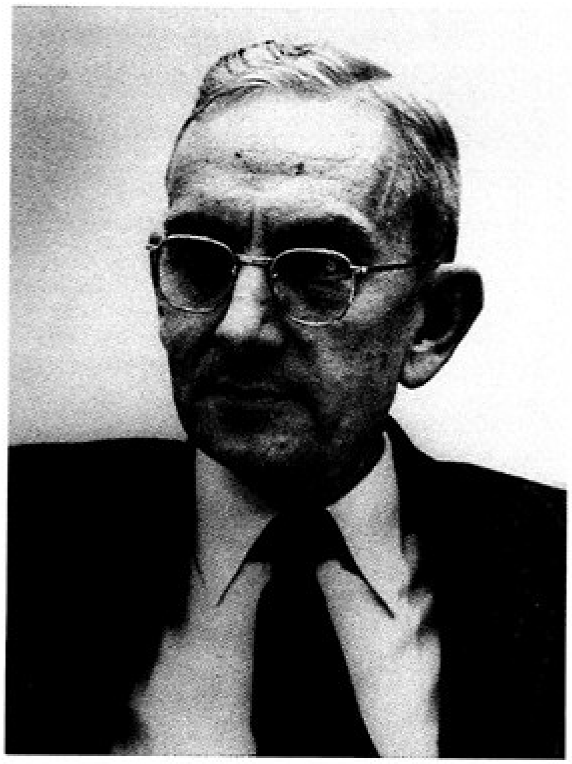
Newell's diversions would be considered important scientific career achievements to most. He collaborated with (NAE member) C. Gordon Bell on a series of works, including the first book to explain clearly and precisely the nature of a computer architecture. With two of his former students, later scientists at Xerox Corporation, he conceived and tested detailed models of human performance in certain skill tasks that were important in the use of computers.

However, the main line of his interest was to model the general "software architecture" of mind. GPS was his first attempt; a suite of programs called Soar was his last. Soar, begun by Newell at CMU, is now a major effort by dozens of researchers to build a general problem solving architecture that incorporates automatic learning and subgoaling.

Newell won all the major scientific awards of computer science, artificial intelligence, and cognitive psychology, including the A. M. Turning Award of the Association for Computing Machinery (1975), the Distinguished Scientific Contribution Award of the American Psychological Association (1985), the Emanuel R. Piore Award of the Institute of Electrical and Electronics Engineers, and the Louis E. Levy Medal of the Franklin Institute. In 1992, shortly before he died, President Bush awarded him the National Medal of Science.

His great contribution as a scientist is not the measure of Allen Newell. The words that best describe him are *gentle, cheerful, smiling, magnanimous, generous*, and of course *large*. There was always the calming influence of having Allen

Newell working with you on a problem, whether a departmental problem, a thesis problem, a scientific problem, or a funding problem. His colleagues and his students came to love him because he gave so much to them—to their science and to their lives.



BRIAN O'BRIEN

1898–1992

WRITTEN BY WALTER P. SIEGMUND SUBMITTED BY THE NAE HOME SECRETARY

BRIAN O'BRIEN died July 1, 1992, at his home in Woodstock, Connecticut. He was a leader in the fields of optics and physical sciences as teacher, research scientist, engineer, consultant, and administrator. He received many awards during his career, including the Medal for Merit, the nation's highest civilian award, for his work on optics in World War II.

He began his formal education at the Chicago Latin School and continued at Yale University, where he received his degree in electrical engineering in 1918 and the Ph.D. in physics in 1922. From 1922 to 1923 he served as a research engineer with Westinghouse Electric Company in Pittsburgh, Pennsylvania. While much of his work consisted of scientific research in physiology, human vision, and several fields of optics, he always applied his training and disciplines as an engineer to the many projects he undertook.

In his studies of the biological effects of solar radiation on tuberculous at the J. N. Adams Memorial Hospital in Perrysburg, New York, in the 1920s, he developed special arc lamps for producing enhanced ultraviolet radiation of the desired therapeutic wavelengths, as well as a unique process for irradiating milk in order to produce vitamin D. One of his devices made possible the ultraviolet irradiation of milk on a production basis using a continuous, flowing, cylindrical curtain both of water, as a shield, and of the milk surrounding the ultra violet source, an elegant solution to a difficult production problem.

In 1930 O'Brien went to the University of Rochester as research professor of physics and optics. He stayed on for twenty-three years, becoming director of the Institute of Optics in 1938. To many of his students of those years, Dr. O'Brien "was" the institute. His dynamic presence and enthusiasm were infectious for both his students and his staff.

During World War II, he led an enormous growth in the institute under section 16.2 of the National Defense Research Committee (NDRC) program. One of the primary activities was the development of many military optical systems, including night vision devices, a field he was again to contribute to in the 1950s and 1960s through his instigation of the early work on fiber optics. The World War II devices included the Metascope, a night vision device using infrared phosphors, and ultra-fast Schmidt optical systems requiring the development of aspheric optics on a production scale. Once again, O'Brien was to use his engineering skills to guide the development of both the instruments themselves and the special processes for their manufacture.

Quite possibly the most ambitious engineering program that he undertook began after an unlikely meeting with Michael Todd, the Broadway producer. Todd hoped to interest O'Brien in the development of the dramatic new motion picture process to rival "Cinerama," then playing to enthusiastic audiences in New York City. When O'Brien joined American Optical Company (AO) in Southbridge, Massachusetts, in 1953, Todd contracted with AO to develop his system, which became known as Todd-AO. This system called for both a new concept in wide-field projection on a deeply curved screen, which O'Brien invented, and the development of an array of special equipment to accommodate the 65–70-mm film. A truly unique aspect of the undertaking was the film printing process for correcting the inevitable distortion produced when projecting a picture on a curved screen from an elevated projection booth. In all this, he directed a large group of optical and mechanical engineers (and a few research types) to ac complish this daunting task. The high technical level of wide-film, wide-screen motion picture presentations today can be thought of as derived from the Todd-AO process.

In the midst of this program, O'Brien also initiated a pioneering project on fiber optics at American Optical. Before leaving Rochester, he had discovered the key to efficient light transmission in optical fibers, namely, the use of a low refractive index coating on the fiber "core." With this basic concept, fiber optics began to take on a practical technology, which ultimately resulted in a major industry centered around the Southbridge area. One of the most important applications of fiber optics proved to be in the form of windows (faceplates) for military night vision intensifier tubes.

O'Brien retired from AO in 1958, but continued his career as a consulting physicist until within just a few years of his death. During this period, he served as chairman of the Division of Physical Sciences of the Nation Research Council in Washington, D.C., a member of the Yale University Council, and chairman of the advisory committee to the Metrology Division of the National Bureau of Standards.

In 1962, at the request of General Ben Schriever, he formed the Air Force Studies Board of the National Research Council to furnish scientific advice and guidance for the Air Force Systems Command. He was also a member of the Science Advisory Board to the U.S. Air Force from 1959 to 1970, and was awarded the Air Force's Exceptional Civilian Service Award twice, in 1969 and 1973.

In 1970 he was asked by the National Aeronautics and Space Administration (NASA) to form the Space Program Advisory Council to advise NASA on future programs. He was also a member of the Space Science Board of the National Research Council. He was awarded the Distinguished Pubic Service Medal by NASA in 1972.

O'Brien was a fellow of the Optical Society of America (OSA), the American Physical Society, and the Institute of Electrical and Electronics Engineers. He served as OSA president from 1951 to 1953. In 1951 he received the society's highest award, the Frederic Ives Medal, for his distinguished work in optics.

In recognition of his lifelong activities not only in science but also in engineering, he was elected to the National Academy of Engineering in 1981.

O'Brien died quietly in his sleep, in full possession of his remarkable mental capacities. Though suffering in later years from some physical disability, he had been extremely fortunate never to have had an extended serious illness or hospitalization, even in those later years.

Brian O'Brien had an encyclopedic knowledge of science and technology. This was combined with an exquisite ability to understand and work with mechanical and electromechanical systems. The combination stood him in good stead throughout his scientific career and no doubt was a key to the ongoing demand for his services as a consultant both to industry and to high levels in government.

This tribute is based, in part, on "Brian O'Brien—Pioneer in Optics," written by Walter P. Siegmund and F. Dow Smith, which appeared in the Optical Society of America's *Optics and Photonics News*, March 1993.

CLARKSON H. OGLESBY

1908–1992

BY EUGENE L. GRANT

PROFESSOR CLARKSON H. OGLESBY of Stanford University died on August 23, 1992. He had a distinguished career in two fields, highway engineering, and construction engineering and management.

His *Highway Engineering*, first published in 1954, has been a leading text and reference book for nearly forty years. Shortly before his death he completed his portion of the manuscript for the fifth edition of this classic, now coauthored with Professor R. G. Hicks of Oregon State University.

From 1950 to 1988 he was active in various administrative and research activities of the Transportation Research Board (formerly the Highway Research Board [HRB]) of the National Research Council. Over the years he held a variety of appointments with the board, including chairmanship of its Committee on Highway Engineering Economy (1969–1970); councilor of its Group 1: Transportation Systems Planning and Administration (1970–1975 and 1978–1982); and chairmanship of Group 1's Section B—Social, Economical, and Environmental Factors (1978–1981). He was author or coauthor of a number of papers presented at HRB meetings; these generally dealt with some aspect of the economic analysis of high-ways. Two papers of which he was the senior coauthor won "best paper" prizes at the 1969 and 1971 annual HRB meetings; one dealt with the economics of design standards for low-volume rural roads and the other with the economic aspects of choices among various possible locations for urban freeways.

After a number of years with the Arizona Highway Department and a couple of years as chief engineer for a construction company, he returned to his alma mater, Stanford University, in 1943 as a member of its civil engineering faculty. Early in his Stanford teaching career he initiated two well-received undergraduate courses, one in construction estimates and costs and the other in construction equipment and methods. Before long there was a graduate program in construction engineering and management that had two full-time, tenured faculty members. As time went on, this program expanded to having four full-time, tenured faculty members and became the model for many similar programs elsewhere, first throughout the United States and, eventually, throughout the world. For several years following his retirement from Stanford in 1974, Oglesby was technical adviser and visiting professor at universities in Colombia, Chile, Australia, and South Africa.

Professor Oglesby received many honors and awards. These included the Golden Beaver Award for outstanding contributions to heavy construction (1964); honorary membership, American Society of Civil Engineers (1982); the S.S. Steinberg Award, American Road and Transportation Builders Association (1983); the Construction Engineering Educator Award, National Society of Professional Engineers (1985); the Peurifoy Construction Research Award, American Society of Civil Engineers (1988); membership, National Academy of Engineering (1989); and the Carroll H. Dunn Award, Construction Industry Institute (1991).

The memorial resolution adopted by the Stanford University faculty, which was prepared by three of his colleagues on Stanford's construction engineering faculty, Professors Raymond E. Levitt, John W. Fondahl, and Boyd C. Paulson, Jr., concluded with the following two paragraphs:

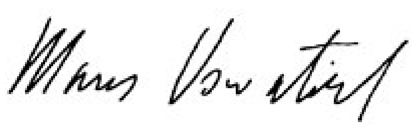
> The professional and academic accomplishments of Clarkson Oglesby are truly remarkable. However, he will probably be remembered long

est and most fondly for the mentorship and advice that he provided to more than two generations of colleagues and students, including the members of this memorial committee. He had an innate ability to perceive the needs, aspirations, and talents of other people, and he had the motivation and interest to help them succeed in life. When a student or friend needed advice, Clark Oglesby was never too busy to listen with genuine concern, and then to ask exquisitely framed questions that enabled students or colleagues to know their own minds, and then make informed decisions that might launch or redirect their careers or personal affairs. At a dinner held in 1991 to establish a graduate fellowship in his honor, past students of Professor Oglesby—many now leaders of large companies or agencies in the construction industry—stood up one after another, choking on their words, as they expressed their appreciation for the measured guidance, the sage counsel, and the deep and caring friendship shown to them by Professor Clarkson Oglesby.

In his life, and right up to his death, his wisdom, humility, warmth and enthusiasm was, and remains, an inspiration to his colleagues, his students, his peers, and his community.

Professor Oglesby is survived by his wife, Ardis; by his daughters, Marjorie Zellner, Judith Donaghey, and Virginia Hancock; and by four grandchildren.

Photograph by Kobé.



KLAUS OSWATITSCH

1910–1993

WRITTEN BY ALFRED E. KLUWICK SUBMITTED BY THE NAE HOME SECRETARY

KLAUS OSWATITSCH died on August 1, 1993. With his death the mechanics community loses one of its most prominent members who has, over the past decades, significantly influenced the development of fluid mechanics in many different areas.

Klaus Oswatitsch was born on March 10, 1910, in Marburg an de Drau, then a city of the Austro-Hungarian Monarchy. He studied mathematics and physics in Graz with, among others, Erwin Schrödinger. Owing to the bad economic situation, he was unable to find a suitable position when he had finished his Ph.D. study. In this difficult situation the twenty-eight-year-old Dr. Oswatitsch especially welcomed a scholarship by the Deutsche Forschungsgemeinschaft that enabled him to do research at the Kaiser-Wilhelm Institute in Göttingen headed by the founder of modern fluid mechanics, Ludwig Prandtl.

As we now know, Oswatitsch's decision to move to Göttingen proved to be a stroke of luck. Even his first scientific investigations showed his exceptional originality. His publications on the dispersion and absorption of sound in clouds, on condensation phenomena in supersonic nozzles, and on drag as the integral of the entropy flow are considered classic papers in the field of fluid mechanics.

Three "wanderjahre" (as he himself termed them) after the war led Oswatitsch to Farnborough, to Emmendingen, and finally to Stockholm, where he taught at the Kungliga Tekniska Högskolan from 1949 to 1956. The wanderjahre—and in particular the time in Stockholm—were characterized by his increasing interest in transonic flow problems, but his widespread interest covered also the regimes of subsonic and supersonic speeds and the fields of hypersonic flow and three-dimensional flow past slender bodies in the whole Mach number range.

His work on transonic flow, which contained groundbreaking results, revealed an interesting feature of Oswatitsch's personality: a once recognized aim was never given up but pursued with heart and soul. In the case of transonic flows this meant that Oswatitsch stuck to this difficult but fascinating field for the rest of his life, even in a period of time in which it was considered out-of-date.

In 1956 Oswatitsch moved to Aachen. Here he founded the Institute for Theoretical Gas Dynamics, which he headed for sixteen years. Accepting an offer from the Technische Hochschule in Vienna, he returned to Austria in 1960, where he stayed until his death. Both in Aachen and in Vienna the investigation of nonlinear wave propagation problems constituted one important focus of his activities.

An attempt to do justice to Oswatitsch's scientific oeuvre, for example, more than 130 publications, including several books and handbook articles, in a few lines is bound to fail. The following considerations will, therefore, be limited to a single paper, which is one of the author's favorites.

The paper published in 1957 deals with the conditions for the separation of boundary layers on the background of Goldstein's discovery that solutions of the Prandtl equations in general develop a singularity at the separation point and can thus not be extended further downstream. Starting from the full Navier-Stokes equations, Oswatitsch was able to show how this singularity can be avoided by constructing appropriate local solutions. In 1957 this alone was an important result, but the paper also carried more information than was or could be recognized at that time.

The solutions derived by Oswatitsch satisfy the Navier-Stokes equations in a small neighborhood of the separation point.

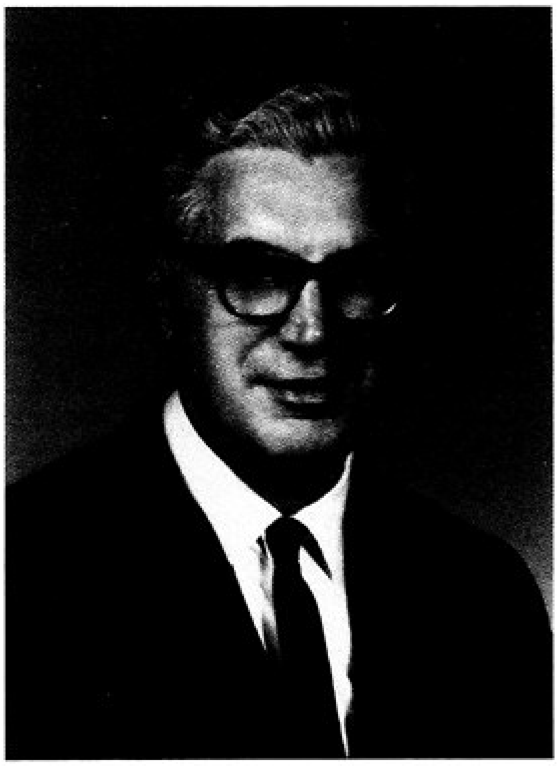
However, they are also local solutions to the Prandtl equations, thus indicating that these equations can in fact, in contrast to earlier presumptions, be used to describe the process of boundary-layer separation. On the basis of this idea, a whole research area—interacting boundary-layer theory—has emerged.

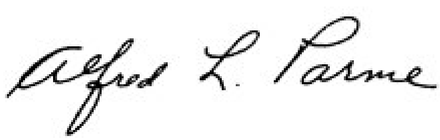
Oswatitsch's influence on his students cannot be fully appreciated without having a brief look at his teaching activities. He was by no means a rhetorically perfect teacher. However, he impressed his students by the act of quickly revealing the essential points of a problem. He never presented final results but allowed the students to see how a theory developed from a few basic assumptions. They never got the impression that to teach was a heavy load. Rather, based on Oswatitsch's enthusiasm, they were led to suspect that to manipulate equations was an enjoyable activity. This may have stimulated them to pursue this source of intellectual delight later for themselves.

During his time in Vienna, Oswatitsch supervised seventeen Ph.D. students. In total, forty young scientists did their doctoral theses under his guidance. Many of them started scientific careers afterward and now hold academic positions in various countries. They all are grateful for many hours of scientific discussion but also for important words of encouragement in times of downheartedness.

Klaus Oswatitsch was awarded many honors and distinctions in recognition of his work. He was a member of the International Academy of Astronautics in Paris, the Deutsche Akademie der Naturforscher Leopoldina in Halle, the Royal Swedish Academy of Sciences in Stockholm, a foreign associate of the National Academy of Engineering in Washington, D.C., and an honorary member of the Gesellschaft für Angewandte Mathematik und Mechanik. He received honorary doctorates from the Universität Karlsruhe, from the Kungliga Tekniska Högskolan, and from the Eidgenössische Technische Hochschule in Zürich. He held the Ludwig Prandtl Ring of the Deutsche Gesellschaft für Luft und Raumfahrt, the Wilhelm Exner Medal of the Österreichen Gewerbeverein, and the Johann Joseph Ritter von Prechtl Medal of the Technischen Universität Wein (Vienna Technical University).

With the death of Klaus Oswatitsch, the fluid mechanics community loses an eminent scientist who had a seminal influence on many areas of his field. His former students lose a dependable counselor and some of them even lose a fatherly friend.





ALFRED L. PARME

1909–1992

BY ANTON TEDESKO

ALFRED L. PARME, a distinguished structural engineer consultant, died in La Jolla, California, on June 28, 1992. He was born in Nice, France, on April 5, 1909. His mother, Fedora Glasse, a native of New York City, was the daughter of a skilled chef. With her father she made numerous trips to France where she met Louis Parme, a young Italian wigmaker-hairdresser, whom she married. Louis went to New York to establish a business, while Fedora remained in Nice where Alfred was born. He came to New York with his mother before World War I and became a U.S. citizen at the age of eight.

Alfred attended a Catholic boarding school while his father trained him in haircutting and styling design. His family ran a hairdressing establishment and young Alfred, as expected by his parents, became a ladies' hairdresser. He was in his early twenties when he decided to quit and pursue an engineering education. This decision caused a break with his father.

Al Parme had outstanding mathematical ability. During the summers he was in demand as a navigator on racing boats for the Long Island Sound and Bermuda races because of his ability to visualize all the complexities of the vectors of wind and tide.

With little money of his own and no high school diploma, he studied for and passed a college entrance exam at Cornell University, where he was admitted to the school of engineering.

While earning a livelihood, he completed the four-year civil engineering course in three years. In later years he attended courses and taught at the Illinois Institute of Technology.

Parme started his professional career with a New York engineering firm on the Santee Cooper Project (hydraulic and hydro-electric work), and he assisted in the design of powerhouses and arch dams. Out of this work evolved a time-saving new method of designing arch dams. Subsequently, Parme joined the Corps of Engineers at Binghamton, New York, where he worked for three years as assistant engineer on the structural design of hydraulic structures. The work also involved feasibility studies of earth dams and investigations on the rate of consolidation and the shear stresses that developed in soft foundations. Among the concrete structures designed were intake towers, spillways, floodwalls, and large tunnels. In latter stages of this work, Parme was entrusted with the supervision of other engineers and the establishment of design procedures.

In 1940 he became a member of the technical staff of the Portland Cement Association (PCA), where he remained for twenty-eight years, except for limited leaves of absence. During such absences he served as consulting engineer with Overseas Consultant Inc. of New York City and was responsible for the design of the first arch dam in Japan and the training of Japanese engineers in methods of investigation of arch dams and the problems associated with the yielding of their foundations. During World War II, he served for two years as a senior stress analyst at Republic Aviation Corporation. He supervised the analysis of indeterminate structures and also provided assistance in solving the more difficult stress problems. He was in charge of the structural design for the XT-84, the company's first jet plane.

At the PCA in Chicago, he was the structural engineer in charge of technical publications and development of design techniques. He assisted practicing engineers on unusual structures requiring specialized knowledge beyond the skills of the average practitioner. He made contributions of an original nature to the design of storage tanks, rigid frame bridges, domes, and shells. It was during this period that he wrote the

180-page manual for the design of cylindrical shell roofs, which is known as the American Society of Civil Engineers (ASCE) Manual 131. He advanced to be manager of the PCA's twenty-man Structural Bureau working on a technical level interspersed with promotional activity.

After a few years he created another position for himself: he became PCA's director of advanced engineering. As head of this special group, he was responsible for maintaining PCA's leadership in structural design. New methods of design were developed, which have become classics in their field. During eight years of its existence, his small select group published more than twenty advanced engineering bulletins, and in addition Parme continued to serve as consultant on unusual projects.

In 1962 he was elected village trustee of Glenview, Illinois, the town where he lived with his family. In 1968 he left the PCA and moved to California where he investigated the earthquake stability of California dams and operated as an independent consultant to government, industry, and many consulting firms. He also worked on the handbooks of the Prestressing Concrete Institute and the Concrete Reinforcing Steel Institute.

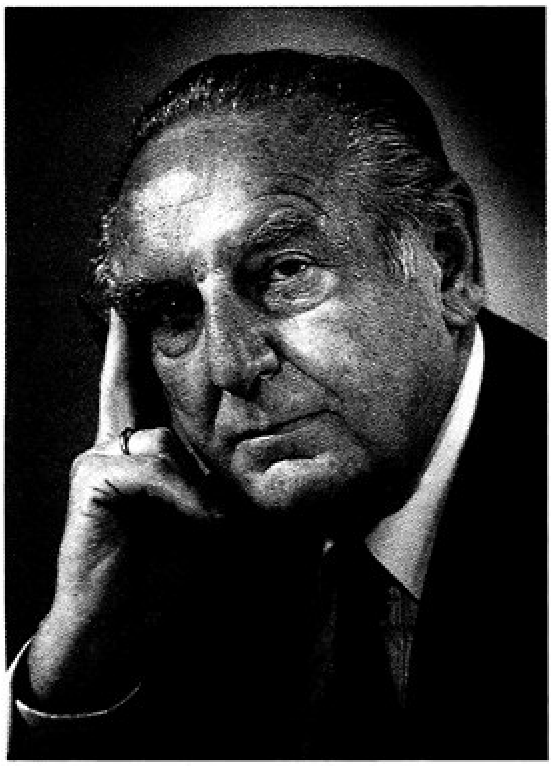
Alfred Parme made outstanding contributions to the theory and practical design of concrete shells, arch dams, nuclear containment vessels, prestressed concrete structures, high-rise buildings, hangars, tanks, and industrial buildings. He was involved in the seismic design of dams in Turkey, California, and Japan. Al Parme was a pioneer in the development of methods of analysis and design of thin concrete shell structures. His influential technical publications on cylindrical shells, folded plates, and hyperbolic and elliptical paraboloids formed the basis for the design of many concrete shells constructed in the United States. His ability to integrate the theoretical, applied, and practical aspects of analysis, and design and construction of all types, was a unique and rare quality seldom found in one individual.

It might be said that Parme's life was an example of the American self-made man. A transformation took place during his life from that of a rough-edged, sometimes unmannerly engineer to that of a competent diplomatic leader of courtly manner and appearance. He was a highly respected participant at domestic and international engineering meetings, which he attended at times as a U.S. representative. Abroad he frequently was addressed as "professor" or "doctor," as people assumed that someone with his knowledge, ability, and competence must have acquired a title.

Among the awards Al Parme received are the Moisseiff Award and the Rickey Medal of the ASCE; the Fuertes Medal of Cornell University; the Martin P. Korn Award of the Prestressed Concrete Institute; and the Alfred E. Lindau Award of the American Concrete Institute. Parme was a cofounder and a vice-president of the International Association for Shell and Spatial Structures (IASS). He also served as a member or chairman of numerous technical committees, including the Earthquake Engineering Research Institute. In 1974 he was elected to the National Academy of Engineering.

Al Parme enjoyed working with his hands, and he enjoyed his garden. He bought a small cabin at Mammoth Lakes in the Sierras. Although he did not ski, he loved to go there with his family for spring skiing. They also used the cabin as a summer home base for hiking and camping. One can visualize Al sitting in front of the cabin with a pipe in his mouth and a book on history in his hand.

Al died after a long illness. He is survived by Ann Banas Parme, to whom he was happily married for forty-four years, and by his four children and seven grandchildren.



EDUARD C. PESTEL

1914–1988

BY FREDERICK F. LING

EDUARD C. PESTEL, industrial designer, researcher in mechanics, educator, and statesman, died on September 19, 1988, at the age of seventy-four.

Elected to the National Academy of Engineering as a foreign associate in February 1981, Eduard worked and studied on three continents. At the time of his election he was minister for science and art of the State of Lower Saxony, Germany. He was born in Hildesheim, Germany, on May 29, 1914.

Eduard attended the Rensselaer Polytechnic Institute and the Technical University (TU) of Hannover, Germany. He received an M.S. degree from Rensselaer in 1939 and a Dr. Ing. degree from the TU, Hannover, in 1947.

His earlier career was in industry. Between 1942 and 1946 he was head of the Engineering Division, Leybold K.K. in Osaka, Japan. From 1946 to 1947 he was director of the Planning and Research Division of Kinzoku Kogyo K.K., the Japanese industrial concern in Osaka.

Upon earning his Dr. Ing. degree, Eduard remained at the Technical University of Hannover. His professional history at the university follows: deputy director, Institute of Mechanics, 1948–1951; dean of faculty for mechanical engineering, 1961–1962; rector (president) of the university, 1969–1970; and professor and director of the Institute of Mechanics, 1957–1977. In 1977 Eduard was appointed minister for science and art of the State of Lower Saxony.

The aggregate effect of Dr. Pestel's work is most unusual for its both strong and wide-ranging impact. Among his many contributions are those that by themselves are unique, but taken together they represent writings and accomplishments of sufficient influence to justify categorizing him as a "universal man" in twentieth-century engineering. His major contributions included the following:

- Publishing and lecturing as an engineering scientist and educator in such fields as computer modeling, ecosciences, elastomechanics, biomechanics, and university reform,
- Authoring the definitive and widely used book *Matrix Methods in Elastomechanics* with F. A. Leckie,
- Initiating and contributing to the field of futurology along with J. W. Forrester and colleagues in the Club of Rome,
- Functioning as a top-level representative of German engineering in industry, academe, and government, and
- Promoting the arts as an accomplished pianist and lecturer.

Eduard was elected a member of the Braunschweigische Scientific Society in 1959. He served as a member of the Senate and Grants Committee of the German Research Society (Deutsche Forschungsgemeinschaft) 1965–1971; as vice-president of the German Research Society, 1971–1977; as the German delegate to the North Atlantic Treaty Organization (NATO) Science Committee, 1966–1988; as a member of the Executive Committee of the Club of Rome, 1969–1988; and as a board member of the Institute for Systems Analysis and Innovation Research of the Fraunhofer Society, Karlsruhe, 1973–1988.

He received an honorary doctorate from Rensselaer Polytechnic Institute in 1970 and from Bochum University in Germany in 1984. He served as governor of the European Cultural Foundation, Amsterdam, Holland; chairman of the Senate of the Fraunhofer Society, München-Gladbach, Germany; and chairman of the board of the Volkswagenwerk Foundation.

Eduard is survived by his wife, Anneliesa, and four children, Rubin, Suzanna, Micky, and Wendy.

HENRY J. RAMEY, JR.

1925–1993

WRITTEN BY WILLIAM E. BRIGHAM SUBMITTED BY THE NAE HOME SECRETARY

HENRY JACKSON RAMEY, JR., Keleen and Carlton Beal Professor of Petroleum Engineering, died November 19, 1993, of leukemia. He is survived by his wife, Alyce, and three children, Jonna, Terri, and Taigh. It would be hard to overstate Hank's contributions to the petroleum engineering profession; to the departments of petroleum engineering at Stanford and Texas A&M Universities; and to the lives of the many students, faculty, staff, and practicing engineers with whom he worked during his long career.

He was a pioneer. He personally led the development of three distinct areas of petroleum engineering technology: *in situ* combustion for recovery of heavy oil; the engineering of recovery of steam from geothermal reservoirs; and the design and interpretation of pressure transient tests of oil, gas, groundwater, and geothermal wells to determine properties of reservoir rocks. Hank made fundamental contributions to each of those areas at their inception, and he wove the three strands into a research effort that continued until his death.

Hank was born in Pittsburgh in 1925. His education was interrupted by World War II. He served as a B-29 navigator in the South Pacific, and after the war, completed his B.S. (1949) and Ph.D. (1952) degrees in chemical engineering at Purdue University. Hank married Alyce in September 1948. He began his research career in 1952 with Magnolia Petroleum Company, a predecessor of Mobil Oil. Over the next eleven years, he held positions in research, production engineering, and reservoir engineering with Magnolia, General Petroleum Corporation (another Mobil predecessor), Mobil, and the Chinese Petroleum Corporation in Taiwan (on loan from Mobil). He began his teaching career as a part-time graduate school lecturer at the University of Southern California in 1960. He moved fully into the academic arena in 1963 as professor of petroleum engineering at Texas A&M University. In 1966 he came to Stanford, where he chaired the Petroleum Engineering Department for ten years (1976–1986), leading its growth and building its stature. He was named to the Beal chair in 1981.

Hank is known worldwide for his contributions to pressure-transient well testing, a technique by which the transient change of pressure in a well, due to injection, can be interpreted to yield information about the properties and size of the reservoir. Hank and his students were responsible for much of the mathematical and practical development of modern well testing. They pioneered the use of log-log type curves as a way of diagnosing well and reservoir characteristics. The theories they developed include the effects of complex fluid flows in and near the wellbore, and as a result, useful information can be extracted from experimental observations that would otherwise be uninterpretable. The Society of Petroleum Engineers (SPE) monograph *Advances in Well Test Analysis* cites his work more than any other person's.

Hank was a key innovator in the development of thermal oil recovery methods, which are applied to displace the heavy viscous crude oils that are abundant in California and elsewhere (Canada, Venezuela, and Indonesia, for example). In the late 1950s he led the South Belridge Thermal Recovery Experiment, a field test of the new *in situ* combustion technique supported by eleven oil companies. Later while with Mobil, he installed several additional combustion operations, all of which proved to be economic successes. Throughout his career he worked with many students to analyze and develop engineering science descriptions of *in situ* combustion and steam injection methods for heavy oil recovery. The SPE mono graph *Thermal Recovery* frequently cites his work, for his research was always practically oriented as well as academically sound.

He pioneered the field of geothermal reservoir engineering. In the 1960s he began to apply the principles of petroleum reservoir engineering to the recovery of steam energy from geothermal reservoirs. In 1972 the Stanford Geothermal Program was established, and it remains the premier geothermal reservoir engineering research curriculum in the world today. Many of his former students dominate the geothermal industry. For his work in this area, he received in 1993 the Department of Energy Award for Exceptional Public Service, the highest recognition that can be presented to someone outside the department.

Many other awards were bestowed on Hank. He won every major award given by the Society of Petroleum Engineers, and he served twice as a distinguished lecturer. He was elected to the National Academy of Engineering (NAE) in 1981. He participated on the NAE Chemical/Petroleum Engineering Peer Committee (1983–1986), the National Research Council (NRC) Board on Mineral and Energy Resources (1984–1987), the NAE Committee on Membership (1987–1990), and the NRC Board of Radioactive Waste Management's panel that evaluated the proposed repository on Yucca Mountain (1990–1992). Hank's professional colleagues worldwide know and appreciate his many technical contributions.

While Hank's research is known to all, he will be remembered most for his personal warmth, his sense of humor, and for his steadfast concern for students. His example created an environment in which good students could develop their intellectual skills in an atmosphere of respect. On the news of his death, messages of regret flooded in from former students from all corners of the globe.

Hank was multidimensional. He read voraciously, researched the history of petroleum engineering, especially at Stanford, and had an ardent interest in aircraft. He and his son Taigh helped fly a relic B-29 from the United States to Britain. The aircraft was restored for museum exhibition after that flight. At the time, it was barely airworthy. Hank's skills in celestial navigation made the flight a success.

Navigation was both a personal and a professional specialty for Hank. His leadership of the Petroleum Engineering Department at Stanford used those skills as well. He always knew where he was, where he had been, and where he was going, and he was a leader in charting a course for the department at Stanford. He will be terribly missed by those whose love and respect he will always hold.

GORDON G. ROBECK

1923–1993

WRITTEN BY JAMES M. SYMONS SUBMITTED BY THE NAE HOME SECRETARY

GORDON G. ROBECK, an internationally known expert in drinking water research and treatment, died on February 21, 1993. Gordon was born February 3, 1923, in Denver, Colorado. He earned a B.S. in civil engineering from the University of Wisconsin, Madison, in 1944 and an S.M. in sanitary engineering from the Massachusetts Institute of Technology in 1950.

Gordon spent his entire professional career in public service, working for the federal government. He joined the U.S. Public Health Service (PHS) in 1944 and remained there until 1974, rising to the rank of sanitary engineering director (navy captain). From 1970 to 1974 he was detailed from the PHS to the U.S. Environmental Protection Agency (EPA). He resigned from the PHS in 1974 and joined the EPA, where he worked until retirement in 1985. When he retired, he was a member of the Senior Executive Service.

Gordon's major professional affiliation was the American Water Works Association (AWWA). He worked through the chairs of the Water Quality Division, becoming chairman of the division in 1970. He was then appointed the liaison member of the Technical and Professional Research Committee of the Water Quality Division and was its vice-chairman. Later (1986–1988) he was the liaison member of the Water Quality Division to the AWWA Research Foundation's Research Advisory Council. In addition, he served on many AWWA committees.

Although Gordon had many assignments in his early career with the PHS, he will be remembered for his accomplishments during the thirty years spent in Cincinnati, Ohio, doing research. He is unusual because he was able to make an impact both as a hands-on researcher and, later, as a research administrator. His early work on filtration, particularly the studies showing that viruses passed through a rapid granular filter at the same time that turbidity breakthrough occurs, resulted in information that is still used today to prevent the passage of pathogenic cysts and oocysts through drinking water treatment processes. Not content to focus on filtration exclusively, Gordon was studying activated carbon adsorption treatment of drinking water long before this topic became fashionable. His work showing the feasibility of such treatment paved the way for the intensive, current research effort on this subject. He was truly a research visionary.

In the late 1960s and early 1970s, the environmental efforts of the federal government were being reorganized. As the drinking water research program was being moved from organization to organization, it kept becoming smaller and smaller (some probably hoped it would disappear entirely), but Gordon kept insisting that the federal government had a role in the drinking water research arena. Finally, his ideas took root, and the trend was reversed.

When this program was placed in the U.S. Environmental Protection Agency and the Safe Drinking Water Act was passed, Gordon's administrative abilities were tested. Three federal laboratories were to be moved to Cincinnati, consolidated, and redirected to working on drinking water. Gordon skillfully managed this difficult transition such that when the formation of trihalomethanes during the chlorination of drinking water was discovered in 1974, he had a talented research team ready to undertake the solution to this difficult problem. In the late 1970s and early 1980s, "Gordon's Gang" was the most productive and credible drinking water research team in the world. When any drinking water problem came up, the solution was "call Gordon, he'll know," and he did, or "get Gordon to come and meet with us," and he would. The momentum he developed in his team was so great that today his former group is still making significant contributions to the field, an important legacy.

To give a specific example of his impact, Gordon would often be asked about the quality of Cincinnati's drinking water. He would reply, "It's safe, but it could be safer." The local political establishment asked how the water could be safer, and Gordon outlined his recommendations. Although it took a while, his advice was followed, and currently Cincinnati has the most modern drinking water treatment plant in the United States. This is a fitting monument to someone who dedicated his entire life to the cause of high-quality drinking water.

Gordon was elected to the National Academy of Engineering in 1980, the first engineer elected from the Environmental Protection Agency.

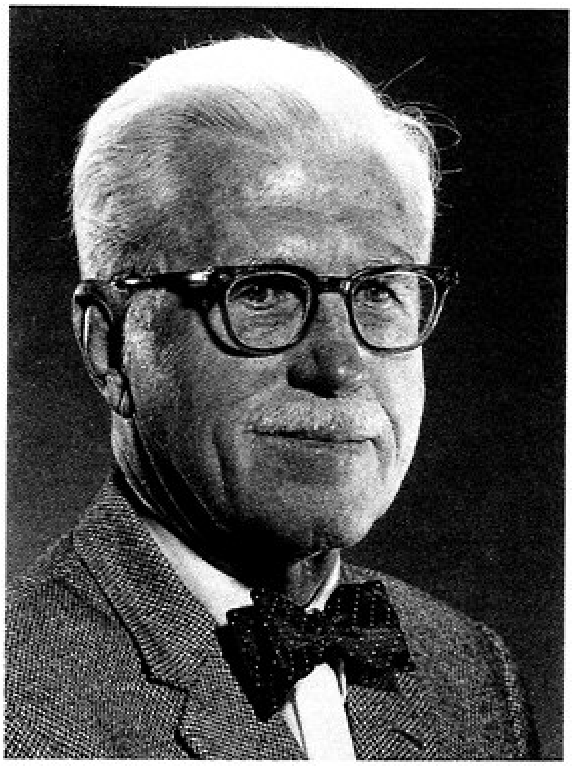
Gordon's participation in National Research Council activities included the following: membership on the Water Science and Technology Board from 1986 to 1989 and service on the board's Committee on Irrigation-Induced Water Quality Problems from 1987 to 1988 and on its Committee on Ground Water Recharge from 1991 to 1993.

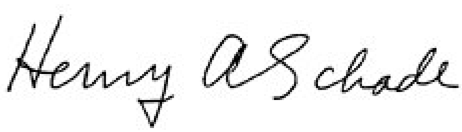
Gordon received many awards; although most were from the AWWA, he was recognized by other organizations. From the AWWA, he received awards as coauthor of the best paper from three different divisions: the Purification Division (1963), the Resources Division (1965), and the Water Quality Division (1968, 1976, and 1977). In addition, he received the AWWA Publications Award for the best paper in AWWA twice (1964 and 1970), the AWWA Research Award (1970), the Medal for Outstanding Service to AWWA (1979), and the Abel Wolman Award of Excellence (1985). From the American Society of Civil Engineers Gordon was awarded the Walter L. Huber Civil Engineering Research Prize (1965). From the U.S. government, he was awarded the PHS Meritorious Service Medal (1971) and the EPA Gold Medal for Exceptional Service (1978). Gordon was recognized with an honorary doctor of science degree from the University of Cincinnati (1985) and a Distinguished Service Citation from the College of Engineering, University of Wisconsin, Madison (1986).

Among his many memberships, Gordon was an honorary member of the American Water Works Association and of the American Society of Civil Engineers. He was also a member of Chi Epsilon, Tau Beta Pi, and Sigma Xi.

Gordon was the author or coauthor of sixty-four publications in the water field. As noted above, several of these publications won awards because of their importance. At the time of his retirement from federal service, the American Water Works Association Research Foundation published a memorial volume of eighteen of his more significant papers. This indicates the quality of his publications.

In addition to being a devoted husband and a dedicated father, Gordon was a lifelong tennis player and singer. On Saturdays you would find him on the tennis court, and Sunday mornings he would be in the choir loft in church. Outside of work, his three passions were his family, his sport, and his church.





HENRY A. SCHADE

1900–1992

BY ALAA E. MANSOUR, J. RANDOLPH PAULLING, EGOR P. POPOV, AND JOHN V. WEHAUSEN

HENRY ADRIAN SCHADE ("Packy" to his friends) was born on December 3, 1900, in St. Paul, Minnesota, and died in his sleep at his home in Kensington, California, on August 12, 1992. He attended the St. Paul public schools and in 1919 was appointed to the U.S. Naval Academy from which he was graduated with distinction in 1923. Following two years at sea, he was selected for the Construction Corps of the U.S. Navy and sent to the Massachusetts Institute of Technology (MIT) for further education in naval architecture. He received the M.S. degree from MIT in 1928. There followed tours of duty at the Mare Island Navy Yard, the design section of the Bureau of Construction and Repair, and the Experimental Model Basin, the latter two in Washington, D.C. In 1935 Schade was sent for further graduate study to the Technische Hochschule, Berlin, and from this university he received the degree Dr. Ing. (with distinction) in 1937.

Upon his return to the United States, he was assigned to the office of the supervisor of shipbuilding of the Newport News Shipbuilding and Drydock Company. During this period Schade played a major role in the development of the Essexclass aircraft carriers, which became the backbone of the fast carrier task forces roaming the Pacific during the latter half of World War II. In 1941 Schade was reassigned to the Bureau of Ships in Washington, D.C., where he was placed in charge of aircraft-carrier design. During this time he was responsible for the design of the Midway class of large attack carriers. These carriers incorporated several significant design innovations. Perhaps the most important of these was treating the flight deck as a strength deck. For his work during World War II he was awarded the Legion of Merit and the O.B.E. (officer rank) of the Most Excellent Order of the British Empire.

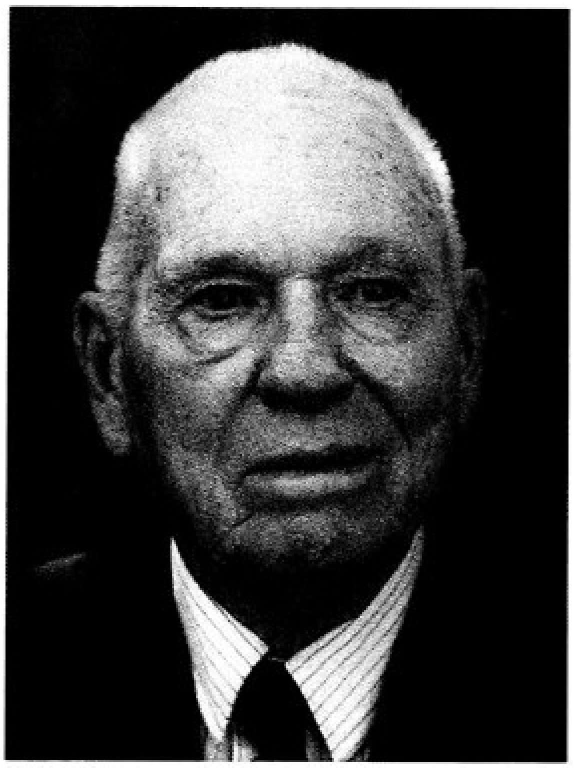
In the summer of 1944 Schade was assigned as the U.S. Navy representative on the scientific mission to Europe, which was responsible for studying and evaluating enemy wartime scientific and engineering accomplishments. A few months later he organized and was appointed chief of the Naval Technical Mission in Europe. As chief of this mission, now with the rank of commodore, he directed a team of specialists in various subjects in the collection of technical information all over Germany. For this work he was awarded the Gold Star in lieu of a second Legion of Merit.

On November 1, 1945, Schade became director of the Naval Research Laboratory, a position that he held until he retired from the U.S. Navy in January 1949 to accept a position at Berkeley as professor of mechanical engineering and director of the Institute of Engineering Research. In the latter capacity he was responsible for the administration of all contract supported research in the College of Engineering. As professor of mechanical engineering he began developing a curriculum in naval architecture as an option within mechanical engineering.

During the next few years he oversaw the construction of a laboratory at the Richmond Field Station for research in ship structures and ship hydrodynamics. In 1958 he organized the Department of Naval Architecture and became its first chairman. With Packy's experience in almost all practical aspects of ship design and construction, he believed the university was the place to learn fundamentals and that practical details could be more effectively learned on the job. Following this philosophy the department started a graduate program with the underlying premise that classroom instruction and research should be mutually supporting and interrelated. One consequence was the introduction of a doctorate program. Packy's former doctoral students now occupy important positions in the world of shipbuilding and offshore engineering. The department's educational philosophy has had an impact internationally and has been emulated by almost all institutions teaching naval architecture. His reputation attracted graduate students from all over the world, and as a result of the international nature of the enrollment, a culturally diverse and intellectually stimulating atmosphere pervaded the department, an effect that continued after Packy's retirement in 1968.

Packy's own specialty was ship structures, and in this field he was preeminent. His reputation attracted to the department others in the field who wanted to spend a sabbatical year with him. Because of his interest in structures, Packy always maintained a close relationship with the Structures Group in the Department of Civil Engineering. As one might expect, his accomplishments have not gone without official recognition. In 1964 he was awarded the David W. Taylor Medal of the Society of Naval Architects and Marine Engineers (SNAME) and in 1971 the Gibbs Brothers Medal of the National Academy of Sciences. He was elected to the National Academy of Engineering in 1973. He has also served on important committees of SNAME and served as a member of its Council for many years. He has been a guest professor at both the Istanbul Technical University and the Technical University in Berlin. From the latter he received the degree Dr. Ing. honoris causa in 1972.

Packy's years of service as a naval officer marked his personal demeanor in noticeable ways, starting with a military bearing, careful attention to personal appearance, and meticulousness about appointments. Yet he was also open and always gentlemanly in his relationships with others. Although somewhat reserved in manner, Packy was friendly with colleagues and students. He was accessible to students and continued to influence them professionally long after they had left Berkeley. A popular and regular feature of the beginning of the fall semester was an open house for students and faculty hosted by Packy and his gracious wife, Alice. His recent years were made more difficult because of a broken leg, the aftermath of being struck by a speeding vehicle, and the long illness of his wife, who predeceased him in 1990. Nevertheless, Packy continued to welcome visits by friends, colleagues, and former students until the end of his life. He is survived by two sons, Henry A. Schade, Jr., of Mountain View, California, and Richard J. Schade of Deerfield, Illinois, and three grandchildren.



GALEN B. SCHUBAUER

1904–1992

BY HANS W. LIEPMANN

GALEN B. SCHUBAUER was born in Sparrows Point, Maryland, on July 7, 1904, and died in Lanham, Maryland, on November 24, 1992, of a heart condition. He is survived by his wife of fifty-five years, Marian; his four daughters, Sally Carter, Nancy Doyle, Mary Thulin, and Betsy de Vergilio; and eight grandchildren.

Dr. Schubauer, known affectionately as "Schubi" in professional circles, began his academic education at Pennsylvania State College and completed it with an M.S. degree from the California Institute of Technology and a Ph.D. from the Johns Hopkins University. He spent his entire professional career at the National Bureau of Standards (NBS), starting as a "junior physicist" in 1929 and retiring as chief of the Fluid Mechanics Branch in 1968. During this time he was author or coauthor of some twenty-five publications, a modest number by present standards. But among these papers are a number that set standards in their field. In particular, the famous Schubauer-Skramstad experiments on laminar instability are one of the most important contributions to modern fluid dynamics.

In every profession, an individual may be highly valued by outsiders and much less so by colleagues intimately acquainted with his specific work. On the opposite end of the scale, an individual may not be well known to distant colleagues and people outside a particular profession but extremely highly rated by experts in the field. Schubi was a prime example of the latter. His relatively late election to the National Academy of Engineering in 1980, almost forty years after his most important work was done, is certainly related to this fact.

The group at NBS was formed and originally guided by Hugh L. Dryden. Dryden, today remembered mostly for his leadership in both the National Advisory Committee for Aeronautics (NACA) and the National Aeronautics and Space Administration (NASA), established at NBS a center for experimental research in fluid mechanics with particular emphasis on turbulence. I believe that the need to understand more about fluid turbulence arose from the task of precision calibration of anemometers. The rapid development of aeronautics and the resulting need for aerodynamic testing required wind tunnels with well-defined flow properties simulating flight in the free atmosphere. The necessity of defining and measuring the characteristics of turbulence thus became of great importance, and the development of turbulence-measuring instrumentation and the design of wind tunnels with low turbulence level became an important task for the NBS group. By the late 1930s the NBS group had become well known both in the United States and abroad. Indeed, in 1939 when as a fresh Ph.D. I came to the United States to join the great von Kármán at Pasadena, he ordered me to proceed first to Washington and the NBS "to get acquainted with the research of the best experimental group in the U.S." It was then that I first met and learned to appreciate Schubi and his unassuming competence and depth of understanding. When Dryden was appointed research director of NACA, Schubi took over the leadership of the group until his retirement in 1968.

During the war years, research in fluid mechanics was driven hard by the near explosive development of aircraft from subsonic through transonic to supersonic speeds; by the need to increase range by minimizing drag; and, in the later development of missiles, by the urgent need to control aerodynamic heating. All of these problems are intimately related to flow in the boundary layer. The dominant problems were—and are—transition to turbulence and boundary-layer separation. The instability of laminar flow is an old problem, but the question whether flow in the boundary layer and plane poiseuille flow were stable was still considered sufficiently important and difficult in the 1920s. Therefore, Arnold Sommerfeld gave it as a Ph.D. thesis subject to one of his most promising students, Werner Heisenberg. Heisenberg confirmed by detailed and complex analysis, an earlier—and at the time suprising—conjecture by Ludwig Prandtl that viscosity could have a destabilizing effect. Finally, Walter Tollmien in 1929 obtained the first theoretical value for a critical Reynolds number and mapped out the complete instability region. However, the laminar instability theory was mathematically quite complex, open to criticism, and apparently at odds with all experimental evidence.

When Schubi decided to confront the problem in 1940 it looked like a dead end. In a relatively short time, his work with H. K. Skramstad confirmed the theory in all important aspects. Using a better wind tunnel, better diagnostics, a completely novel method for exciting the perturbations, and in particular a much better understanding of the physics of the problem, the two produced a classical contribution to fluid mechanics. They realized fully the important difference between the onset in instability and the onset of turbulent flow, and they developed new techniques to study the laminar instability waves, which only eventually result in turbulent flow. It is not easy today to appreciate the difficulties faced in doing this type of experimental research in the early 1940s when straight configuration testing dominated. Unfortunately, the impact of this work was at first limited, simply because experiments related to laminar-turbulent transition were at the time classified. The publication of the results in open literature had to wait until 1947, but for experimentalists in fluid dynamics, the approach and execution of the Schubauer-Skramstad experiments had an immediately profound impact. Having been one of them, I can vouch for that! The aeronautical community did appreciate the work, and the authors received the Reed Aeronautics Award from the American Institute of Aeronautics and Astronautics (AIAA) in 1947.

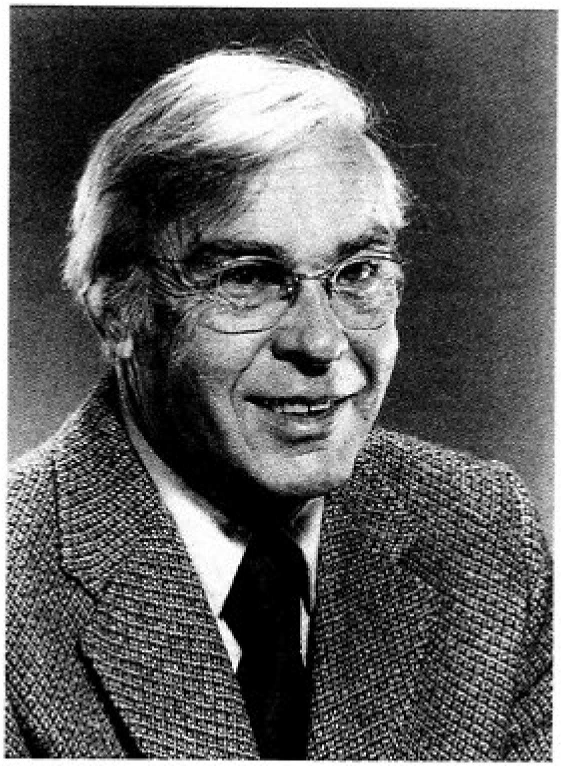
The research on laminar instability is unquestionably the largest contribution Schubi made to the state of the art.

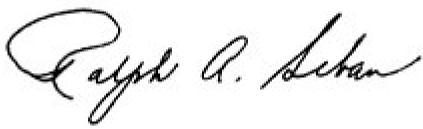
However, at least three more of his papers had a lasting effect. These were "Investigation of Separation of the Turbulent Boundary Layer," published in 1950, and "Contributions on the Mechanics of Boundary-Layer Transition," published in 1956, both coauthored with P. S. Klebanoff and the 1960 paper "Forced Mixing in Boundary Layers," coauthored with W. G. Spangenberg. The experiments reported in these papers all show the traditional care and competence of the NBS group as well as their ability to select problems of fundamental scientific importance with great impact on engineering applications.

Schubi was a fellow of the American Physical Society, the American Institute of Aeronautics and Astronautics, and the Washington Academy of Sciences and a member of the Philosophical Society of Washington.

In addition to being elected to the National Academy of Engineering and awarded the Reed Aeronautics Award of the AIAA, Schubi's honors included the 1944 Washington Academy of Sciences' Award for Scientific Achievement in engineering sciences and the 1988 Fluid Dynamics Prize of the American Physical Society.

Dr. Schubauer was a superb star in the NBS constellation Dryden-Schubauer-Klebanoff. His death is a great loss for all of us in the science and engineering community.




Ralph A. Seban

RALPH A. SEBAN

1917–1993

BY SALOMON LEVY

RALPH A. SEBAN, professor of mechanical engineering and world-renowned expert in heat transfer and fluid flow, died on June 13, 1993, at the age of seventy-six.

Elected to the National Academy of Engineering in 1978, Ralph was a dedicated teacher and researcher known for his technical expertise and his willingness to pass his knowledge and the latest technical advances on to his many students and the broader technical community.

During his career, which extended over forty-five years, Ralph worked on a variety of heat transfer topics, equipment, and conditions. He had more than sixty publications covering boundary layer, pipe, film, and separated flows as well as natural and forced convection, radiation, boiling and condensation, freezing and ice formation, and wall jets. His publications are noteworthy not only because of the breadth of areas covered but also because they are of the highest quality. They generally include both experimental and analytical work. Many of his papers have opened the way for subsequent contributions by others.

Ralph received all of his university degrees, including B.S., M.S., and Ph.D., from the University of California, Berkeley. In addition to his research and teaching on the Berkeley faculty since 1946, he served for seven years as the chairman of the Heat Power Systems Division (1958–1965) and for four years as the chairman of the Mechanical Engineering Department

(1965–1969). During his extended tenure at the University of California, Berkeley, he provided the professional and technical leadership to make the Berkeley heat transfer group one of the world's leading research and teaching centers in that field.

Ralph was an involved member in the heat transfer community and has served in many capacities in professional activities, including the chairmanship of the American Society of Mechanical Engineers (ASME) Heat Transfer Division. He helped organize and contributed to most national and international heat transfer conferences. For his outstanding contributions to education and research in heat transfer and his professional service, he received the ASME Heat Transfer Division Memorial Award in 1963, and he was elected to the grade of fellow in ASME in 1970. He became an honorary member of ASME in 1977 and was awarded the ASME-AIChE (American Institute of Chemical Engineers) Max Jakob Memorial Award in 1980.

Another outstanding contribution of Professor Seban was the number of students he guided through graduate studies. A large fraction of those students went on to become well known in both the academic and the industrial world by applying the same principles of high integrity and quality they had learned from Ralph. In June 1982 several of his students and some of his associates held a special meeting at Berkeley on the occasion of his sixty-fifth birthday. The papers presented at that session were published in a Festschrift issue of the *International Journal of Heat and Mass Transfer* (Volume 25, No. 6, 1982).

Professor Seban was a devoted family man. He is survived by his wife, Jean, who fully supported him in his career and personal life, and by five children. They can all be proud of Ralph's many accomplishments and contributions to the world heat transfer community.

LEVERING SMITH

1910–1993

BY WILLIS M. HAWKINS AND MANY OTHERS

Unique in the World of major technical developments, especially those involving the U.S. government, is the continuing success of the nearly forty-year U.S. Navy Polaris-Poseidon-Trident program. It may have set an unattainable standard for any equally important national endeavor. The foundation of that success most certainly was the leadership and quiet vision of Levering Smith, retired vice admiral, U.S. Navy. Levering died on April 5, 1993, leaving a void among his peers that cannot adequately be described, and a legacy of lifelong accomplishment in support of his nation that history may not fully appreciate because of Levering's reasoned and humble approach to each new challenge.

There would be no lack of contributors to a chronicle of Levering's towering intellect, his respect for every person who participated in his endeavors, and the integrity of his actions and decisions. Everyone who has ever worked with, or for, Levering knows of his patient, open approach to each new goal—using, and giving credit for, every sound idea and accomplishment. Levering's leadership style was almost the antithesis of that of the textbook, dynamic, emotional leader about which stories are told. He was a leader because he respected the goals of his superiors, respected the responsibilities he had been given, and respected the capabilities of those working for and with him, and he made this apparent to everyone without ever a touch of ego.

Searching through Levering's history for clues to his ultimate development offers little insight. After graduation from the Naval Academy in 1932, he served aboard surface warships in a variety of general line assignments and completed a postgraduate course in ordnance engineering in 1940. During the war he participated in eleven major campaigns during which he survived the sinking of USS *Hornet* and USS *Northampton*.

Levering's more specialized technical contributions began with his assignment in 1944 to the Research and Development Division of the Bureau of Ordnance. This was followed by seven years at the Naval Ordnance Test Station, Inyokern, California, where he became head of the Explosives Department and then associate technical director—the only military officer to have been chosen for that position. After Inyokern Levering was assigned as head of the Explosive Department at the Naval Ordnance Missile Test Facility at White Sands, New Mexico, where he also served as navy deputy to the commanding general.

My first experience of a technical nature with Levering was during the first days of what was to become the Polaris program. Following a 1955 National Security Council recommendation that part of the intermediate range ballistic missile force be sea based, the navy joined with the army in a program to deploy the liquid-fueled Jupiter missile on surface ships and assigned then Rear Admiral William F. "Red" Raborn as director of the new Special Projects Office, reporting directly to the secretary of the navy. Since Lockheed had won an earlier competition by the U.S. Navy Bureau of Aeronautics for a submarine-launched ballistic test vehicle, Raborn chose Lockheed to be prime contractor for a solid-fueled version of Jupiter. Raborn almost immediately drafted Levering from White Sands to lead this work because of his reputation as the navy's preeminent expert on rockets and solid propellants. It was the beginning of an assignment that ultimately produced the most convincing and effective of the nation's strategic deterrent weapon systems.

Levering's planning, which Admiral Raborn accepted, included an innovative and critically important approach to the definition of the requirements toward which everyone on the team worked. It was obvious that a true deterrent weapon had to have enough range to reach important targets from areas of the ocean large enough to obscure potential launch points. The oceanographers and strategists didn't work in isolation. It was Red's and Levering's contention that the entire team should participate so that each member recognized the critical issues and the relative importance of the goals. A "board of directors" was formed, which was called "the steering task group." Red was the chairman, and Levering was the responsible architect of what the task group was to do. Represented were the leaders of the participating universities, the navy commands who would need to support the program, and the responsible executives of the prime contractors and the critical subcontractors. Part of the strategy was to put on the steering task group not the program directors but their bosses. It was a powerful task force, and it spent three months defining the total program including schedules, costs, performance goals, and the distribution of the task among the members. This was a revolution in management. It wasn't a "method"; it was pure Levering—understand the problem; agree on the approach and risks; and define and agree on the real requirements, the schedule relationships, and the resources required. Once the program was defined and understood, the steering task group met nearly monthly agreeing on changes, modifying plans, and adjusting resources. Everyone was focused on the total task, not an individual element. An example of early goal setting was the range of the Polaris. If the Polaris didn't go 1,200 nautical miles, it couldn't justify its existence; similarly, if its accuracy didn't meet a minimum, it shouldn't be created. However, if the accuracy was adequate and the range approached 1,500 to 2,000 nautical miles, a lot of sea room opened up to improve the invulnerability of the submarine. There were no fixed specifications, just the bottom limits to ensure a total system effectiveness—again, pure Levering. Supplementing this broad policy, Levering Smith and Red Raborn initiated and encouraged a true team effort among the military, civil service personnel, and contractors. Adversarial conditions were quickly sorted out and eliminated. In addition, the facts—failures as well as triumphs—were always available to the world outside of the Department of Defense and Congress as needed. This concept had never penetrated normal Washington procurement mores, but it was the foundation for a monumental success. We must hope that history recognizes Levering's fine hand and mind in creating such an environment. This was real management.

In trying to encompass the essence of the man, there were many contributions from those who worked for him and knew him well. These were all consistent and nearly identical. He was what he appeared to be: a highly intelligent, rational, practical engineer with immense respect for those around him, particularly those with good ideas and a reasonable approach to developing them. And above all, he was a gentleman.

From Derald Stuart: "I found Levering to be a true officer and a gentleman—very patriotic with a deep love for the navy and always polite. He was also quick thinking but shy and unassuming. He had a tremendous sense of humor. He was a man of great integrity, scrupulously honest with others and with himself."

From armed forces management: "In sum, say his navy backers ironically, probably the most amazing thing about Levering Smith's monumental performance, both technically and as a manager, is that he has managed to do all this while remaining virtually anonymous."

The *London Daily Telegraph*: "It was no small measure due to him [Levering Smith] that the British Polaris programme was completed on time and on budget—an unprecedented feat in British naval history."

C. W. Chuck Wallace: "I've often thought how I might describe Levering, whom I deeply admired. First comes to mind absolute integrity, factual, highly intelligent, patriotic, and with all that—practical."

Rear Admiral Robert A. Wertheim (retired): "Throughout the development of the Polaris family of weapons, the transition to the more potent Poseidon and the conceptual exploration that led to the present Trident system, Levering Smith led either the technical team or the entire program. Thus, he contributed over twenty years of intelligent leadership, utiliz ing the combined assets of the country from our universities, government labs, and industry."

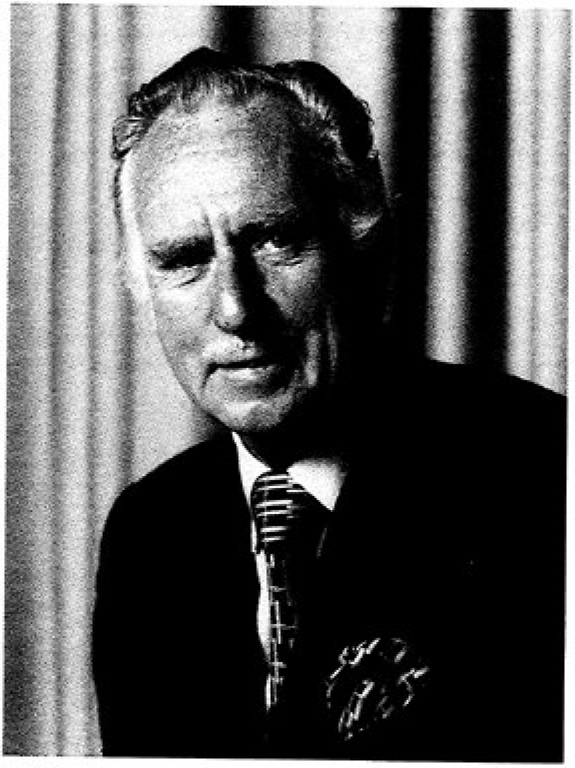
Dr. Werner R. Kirchner (before Admiral Smith's death): "I remember our early days of the Polaris development and your bi-weekly visits to Aerojet and Lockheed, closely monitoring the minute details of the fleet ballistic program. All of us on the navy steering task group often remarked how very fortunate not only the navy but also the country was, to have such an exceptional director of the special program office. With your keen judgement, you invariably steered us on the right course." And, "Levering Smith will always be remembered as insisting upon what was narrowly vital, not necessarily what was broadly appealing."

The navy, the country, and even our allies overseas, did recognize Levering's talents and accomplishments in spite of his unassuming personal presence. Three times he received the highest navy award for noncombat service, the Distinguished Service Medal. He was awarded the American Defense Service Medal with one star, the Asiatic-Pacific Campaign Medal with eleven stars, and many more. On January 7, 1972, Rear Admiral Smith received a high "Order of Chivalry" from Queen Elizabeth II of England. This made him "Honorary Knight Commander of the Most Excellent Order of the British Empire." His technical peers showed their respect by the L. T. E. Thompson Award (1957, Naval Ordnance Test Station). He was also awarded the C. N. Hickman Award (1957, American Rocket Society); the American Society of Naval Engineers Gold Medal (1961); the William S. Parsons Award (1961, Navy League of the United States); the Gold Knight of Management Award (1972, National Management Association); and an honorary doctor of laws degree (New Mexico State University). Levering was elected to the National Academy of Engineering in 1965.

With all of his technical and managerial accomplishments, Levering was also a complete, understanding, and gentle human being. His sense of humor was spontaneous, the sparkle never left his eyes, and his devotion to his beloved wife of over sixty years was apparent in his work and every action. "Boots"

(Beulah W. Lewis) married Levering at the very beginning of his career. Boots was his most ardent supporter as he served our nation.

In total appreciation, all of those privileged to know and work with Levering would, I am certain, agree that if this nation can maintain an environment in which leaders like Levering Smith can emerge, we should have no fears for our future.



MONROE EDWARD SPAGHT

1909–1993

WRITTEN BY JOHN F. BOOKOUT SUBMITTED BY THE NAE HOME SECRETARY

MONROE EDWARD SPAGHT, a research chemist and former president and chairman of Shell Oil Company, died June 27, 1993, at the age of eighty-three.

Born near Eureka, California, December 9, 1909, Monty Spaght worked his way through college playing trombone in a jazz band, graduating with a major in chemistry from Stanford University where he also earned his M.A. and Ph.D. degrees. A fellowship from the Institute of International Education (IIE) enabled him to study physics for a year at the University of Leipzig in Germany. He remained a lifelong supporter of the IIE and a vocal proponent of quality education.

Dr. Spaght joined Shell in 1933 as a researcher. He was responsible for many contributions to scientific books and journals, and was credited with a number of important patents involving the recovery of chemical by-products from refining; by 1940 he was a manager of the company's technical activities on the West Coast. During the Second World War he served on a naval technical mission to Europe, moving into Germany with the Allied forces to study technical developments in German industry. Soon afterward he spent seven months in Japan as a director of the United States Strategic Bombing Survey analyzing the effects of bombing on Japanese industry.

Upon his return from these duties, Spaght resumed his progress up Shell's corporate ladder, first as vice-president and then president of Shell Development Company. In 1953 he was promoted to executive vice-president and elected a director of the company. He became president and chief executive officer of Shell Oil Company on January 1, 1961, and served in that position until 1965, when he became the chairman of the board of Shell Oil Company and the first American appointed a managing director of Royal Dutch/Shell Group of Companies, the parent company of Shell Oil. So remarkable was Spaght's induction that it required an alteration of the parent company's long-standing bylaws on nationality; until then the team of managing directors had been made up exclusively of Dutch and British members.

Spaght retired from both positions in 1970 but continued to serve as a director of Royal Dutch Petroleum Company and Shell Oil Company until 1980.

At various times over a long career Spaght was a trustee of Stanford University, a director of the Stanford Research Institute and the American Petroleum Institute, and a trustee of the Institute of International Education. *Fortune* magazine in 1966 described him as belonging to "that modern-day school of executives who are distinguished for their strong sense of social responsibility," and as one who took on public service activities "not as a dilettante or figurehead, but as a vital and knowledgeable leader." In his social views he combined a love of order and civilized behavior with a passion for justice and fair play. His interest in education was by no means superficial, and his legacy can still be seen in the Shell Companies Foundation, which he helped organize and once directed.

Monty Spaght was elected a member of the National Academy of Engineering in 1969. He was cited for his creative management of research, design, construction, and operation in the petroleum and petrochemical industry. Spaght was also a member of the American Chemical Society and a fellow of both the American Institute of Chemical Engineers and the American Association for the Advancement of Science.

His many honors and awards included the Midwest Research Institute Annual Award (1962) "for contributions to the advancement of technical knowledge, advocacy and utilization of scientific research, and support of education"; the Chemical Industry Medal from the American Section of the Society of Chemical Industry (1966); the Axel Johnson Lecture from the Royal Swedish Academy of Engineering Sciences (1966); and numerous honorary degrees from colleges and universities. He belonged to the Order of Francisco de Miranda from the Office of the President of Venezuela (1968) and held the honorary rank of commander, Order of Orange-Nassau from the Chancery of Netherlands Orders (1970).

Among Monty Spaght's many publications, perhaps the most widely read and admired was *The Bright Key*, a book on the relation of business to research and education. Never has the case for business and corporate support of higher education been made more eloquently and persuasively. *The Bright Key* showed Spaght to be decades ahead of his time in his championing of excellence and quality, and John Gardner's introduction described Spaght as one of those sorely needed individuals "who can work with complex organizations yet retain their individuality, who can master technology yet retain their humanity, who can move easily between reflection and action." Spaght often discoursed within Shell on the ancient Greek ideal of *arete* (excellence) as a way of life. In Monty's words, "*Arete* conveyed the idea of wholeness, of the fullest and finest exercise of one's abilities in all activities recognized as good. The Greeks prized it, strived for it, recognized it, and rewarded it wherever it appeared." Needless to say, Spaght urged Shell managers to do the same.

Wholeness, of course, requires not only a great deal of imagination but considerable tolerance for opposing views and creative conflict. Indeed, Coleridge said that the power of imagination "reveals itself in the balance or reconcilement of opposite or discordant qualities." By that standard, or any other, Spaght certainly possessed imagination; he once described a good research director as "a man imbued with a chaste spirit of scientific inquiry, and a good sense of double-entry bookkeeping." It was this sort of unlikely combination of apparently opposed qualities that Spaght not only valued but embodied. He knew that a research scientist, however idealistic, could not afford to imagine himself opposed to his company's profit-making purpose. Nor could a profitable and successful company remain that way for long if it mistook the idealism that energized its researchers for impractical naivete. Monte Spaght simply refused to regard these conflicting forces as irreconcilable, and by uniting them brilliantly in his own person, he provided unparalleled leadership by example. If there was a secret to his leadership style, it was a refreshing combination of maximal individuality and minimal egotism.

Anyone seeking to understand life in Shell Oil Company and the Royal Dutch/Shell Group would do well to start with Spaght's charming autobiography, *The Long Road from Eureka*, published in England in 1986. *The Multinational Corporation: Its Manners, Methods, and Myths*, another of his most informative books, appeared in 1978.

As president of Shell Oil, Spaght excelled at fostering cooperative action or, as he put it, "the establishment of an environment of maximum freedom in which a man can perform to his full ability. What a president can do, at most, is help an organization to flower." Flower Shell did under Spaght's leadership, particularly in marketing, with simplified lines of communication and decision making, combined with creation of a system for basing marketing decisions on sound economic analysis.

Monty Spaght was a perfect spokesman for Shell and the oil industry in the turbulent decade of the 1960s when the rationale of almost every institution came under intense scrutiny. He was a living refutation of the stereotypical view that large corporations, and particularly oil companies, were cold, heartless, irresponsible, and dehumanized organizations. He was easily approachable, and no one who ever met Monty Spaght or spoke with him, however briefly, came away with stereotypes unchallenged.

As a young researcher, Spaght was the kind of person a large corporation dreams of recruiting. As an administrator, he was the kind of leader a young researcher dreams of working for. As a friend, colleague, or mentor, Monty Spaght was a man who would have been a credit to any organization or endeavor. We will never know what contribution he might have made had he remained a research chemist, but on the path he chose—or that chose him—his impact was large and lasting, his role was vital, and his gifts were many and remarkable.

ERIC E. SUMNER

1924–1993

BY SOLOMON J. BUCHSBAUM

ERIC E. SUMNER, a retired vice-president of AT&T Bell Laboratories, died suddenly on January 19, 1993, while working at his computer terminal. He was sixty-eight. At the time of his death he was serving as the chairman of the Institute of Electrical and Electronics Engineers (IEEE) Strategic Planning Committee and vice-chairman of the IEEE Nominations and Appointments Committee. He served as president of the IEEE in 1991. Eric is survived by his wife, Anne-Marie, and four children. His son, Eric E., Jr., is a research engineer and is head of a software engineering research department at AT&T Bell Laboratories in Naperville, Illinois.

Eric Sumner was born in Vienna, Austria. He was brought to the United States at an early age and was educated here. He lived in and attended public schools in New York City. He received his B.M.E. degree from Cooper Union in 1948, and his M.S. (in physics) and Ph.D. (in electrical engineering) degrees in 1953 and in 1960, respectively; both graduate degrees were awarded by Columbia University.

His English was fluent, of course—not so his German—perhaps with a tinge of an accent, which made it a delight to listen to his oratory. There was a certain flair about Eric Sumner, a debonair demeanor that was unmistakable. For example, he always drank his tea and coffee from porcelain cups, properly served, never from paper or plastic cups.

Eric joined Bell Laboratories in 1948 and soon established himself as an engineering inventor par excellence, specializing in switching and transmission systems development. He led the development of the first commercial pulse-code modulation system. This T1 system became the most widely used transmission system in North America and signaled the start of the digital era. He was promoted to director of Bell Labs' work on antisubmarine detection systems, where he applied new automated detection and data processing to those worldwide systems. In 1967 he was promoted again, to executive director of the Transmission Media Division with responsibility for a new laboratory in Atlanta, Georgia, tied to a "mother" factory in the same city. This period in his career saw the birth of electronic loop transmission systems, so-called SLC systems, and the design and manufacture of early optical fiber and cable systems. Spurred by the recurring service problems of the early 1970s, he pioneered the design of a family of "operations systems"—computers, software, sensors/controllers and terminals—used to design, install, monitor, operate, and reconfigure as well as maintain complex communications systems—a field that now pervades not just communications but all businesses, from airlines to banks.

He was elected vice-president, Computer Technologies and Military Systems Division in 1981. Under his drive, the many internal versions of UNIX were coalesced into a single operating system for universal use, allowing portable application software—an area of growing commercial importance. He foresaw the need for increased software productivity as a business necessity and led a major architectural and technical thrust to satisfy this need. Over a three-year period, he managed to triple the productivity of certain software systems. Then from 1984 until his retirement in late 1989, Eric was vice-president of operations systems and network planning.

Eric Sumner was an expert in research and development management and business analysis, especially troubleshooting, functional audits, and efficiency evaluation. He was granted eleven patents and several honors. He received the following awards: the Alexander Graham Bell Medal of the IEEE; the

1988 Computer and Communications Prize (NEC Corporation); the Gano Dunn Medal for Engineering Achievement from Cooper Union; and the Cooper Union Distinguished Alumni Citation. He was elected to membership in the National Academy of Engineering in 1985.

Eric served on many professional and advisory boards and committees. In addition to his serivce to IEEE, Eric advised the following organizations: National Research Council; American Society of Mechanical Engineers; Georgia Institute of Technology; University of Virginia; University of California, Davis; and Cooper Union.

Eric and Anne-Marie were a delightful couple, a pleasure to be with on any occasion. Eric's many achievements will be long remembered by his many colleagues and friends at Bell Laboratories. Well remembered in particular will be his success in introducing dance music at the annual Bell Labs management conferences.

RICHARD HENRY TATLOW III

1906–1993

BY WALLACE L. CHADWICK

RICHARD HENRY TATLOW III, renowned professional civil and mechanical engineer, entrepreneur, statesman for his profession, designer of retail and commercial complexes for major enterprises, and director of industrial facilities for the U.S. Army during World War II, died at age eighty-seven, at his home in Scarsdale, New York, on July 1, 1993.

Mr. Tatlow was born May 27, 1906, in Denver, Colorado. He graduated from the University of Colorado in 1927 with a B.S. degree in civil engineering. He was a member of Tau Beta Pi and Sigma Tau and was awarded the George Norlin Award, the highest honor awardable to an alumnus of the university. He received a master's degree in 1933.

Mr. Tatlow's first job was for two years as a junior engineer with the U.S. Bureau of Public Roads, following which he became a partner of Harrington and Cortelyou, consulting engineers of Kansas City, working there until 1940. In 1941 he was commissioned lieutenant colonel, then colonel, U.S. Army Corps of Engineers, general staff.

In 1946 he became a member of the board of directors and president, then chairman of the board of Abbott, Merkt and Company, Inc.

Mr. Tatlow was the author of numerous articles on diverse technical subjects such as movable bridges, materials handling, storage and distribution of merchandise, and shopping centers.

He was a perennial representative locally, nationally, and internationally of significant professional, quasi-governmental, and government organizations and of their committees. In 1960 he became president of the American Institute of Consulting Engineers. In 1968 he was elected president of the American Society of Civil Engineers. He served as trustee of the United Engineering Center for many years.

Mr. Tatlow was elected to the National Academy of Engineering in 1967. He served on the National Academy of Sciences' Super Sonic Transport-Sonic Boom Committee at the request of President Lyndon B. Johnson and on the New York City Science and Technology Advisory Board by appointment of Mayor John V. Lindsay. Mr. Tatlow was chairman of the National Academy of Sciences' Division of Engineering and Industrial Research, Building Research Advisory Board. His breadth of interest extended to the animal world when he served as a director of the Animal Medical Center in New York City. He was a member of the famed Cosmos Club of Washington, D.C., and of the Union League Club of New York.

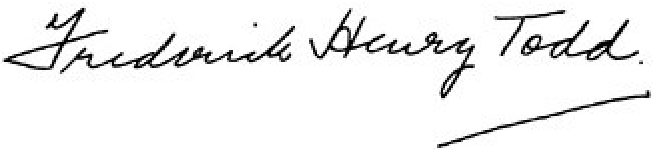
In 1960 Mr. Tatlow exercised his wide range of high technical interest when he became one of the founders of the NUS Corporation, a firm specializing in nuclear engineering, with side interests in biological and underwater systems, air and water pollution, systems analysis, and business management.

Mr. Tatlow is survived by his wife of sixty-one years, Annette Hart Tatlow; a son, Richard Henry Tatlow IV of Bronxville, New York; a daughter, Beedy Tatlow Ritchie of Los Angeles, California; a sister, Laurene Tatlow Gandy of Seattle, Washington; and five grandchildren.

Mr. Tatlow was a friendly man of much charm. His wide interests are also shown by his membership in the Chevy Chase Club of Washington, D.C.; the Fox Meadow Club of Scarsdale, New York; Shenorock Shore Club of Rye, New York; Newcomen Society of North America; and the American Society of Mechanical Engineers of which he was a fellow.

The character of the man is well described by his son, who is recorded to have said, "My father was a kind, gentle, and caring man—a true gentleman of the old school."

Official photograph of the U.S. Navy.



FREDERICK HENRY TODD

1903–1992

BY WILLIAM B. MORGAN

FREDERICK H. TODD, an outstanding research naval architect, died on August 20, 1992, at the age of eighty-nine. He retired in 1969 from the Naval Ship Research and Development Center (formerly the David Taylor Model Basin) and lived his last remaining years near Newcastle upon Tyne, England, where he was born on January 6, 1903.

Dr. Todd was a naval architecture student from 1919 to 1925, receiving his B.Sc. in naval architecture from the Durham University, England, in 1925. During the pursuit of his education, he served an apprenticeship with Armstrong, Whitworth and Company, Shipbuilders, in the shipyard drawing and designing office and joined that company for one year after receiving his B.Sc. degree. He subsequently won the honor of being a 1851 Exhibition Scholar at the Durham University from 1926 to 1928 and received his Ph.D. from that university in 1931.

In 1928 Dr. Todd became a scientific officer at the Model Ship Testing Tank, National Physical Laboratory, Teddington, England, where he had charge of models and research projects. In 1940 he became professor of naval architecture at Durham University and returned to the National Physical Laboratory in 1942 as deputy superintendent of the Ship Division. While at the National Physical Laboratory during World War II, he directed all model experiments and crew training in connection with the design of the artificial harbors used in the D-Day landings of British and American forces on the beaches of France. The overall design included massive concrete structures that could be towed across the channel to form breakwaters and emplacements for artillery, portable piers that rose and fell with the tides, and floating bridges for the off-loading of men and equipment.

In 1948 Dr. Todd came to the United States to take the position of chief naval architect and technical director of the Hydromechanics Laboratory at the David Taylor Model Basin. He held this position until 1957 when he rejoined the National Physical Laboratory as director of the Ship Hydrodynamics Laboratory. He returned to the David Taylor Model Basin in 1962 as scientific adviser to the commanding officer and was later scientific adviser to the technical director. In 1967 he was assigned to the Office of Naval Research Branch Office in London from which he retired in 1969.

Dr. Todd was a prolific author of more than one hundred fifty archival technical papers. His best-known works are his papers on Series 60 hulls, first published in 1957. These works provide a compendium of ship powering and resistance data developed from methodical testing of ship models in a towing tank. This standard hull series is still actively used. His other numerous professional publications include two books: *Ship Hull Vibration*, published in England in 1961, and its companion volume, *Ship Resistance and Propulsion*. From the Society of Naval Architects and Marine Engineers, he twice received the Captain Joseph H. Linnard Prize for the best paper presented at the society's annual meetings in 1951 and 1957. He was the first awardee of the Gibbs Brothers Medal by the National Academy of Sciences, in 1965, for his outstanding contributions to naval architecture and marine engineering. He was elected a member of the National Academy of Engineering in 1965. In 1967 he received the Davidson Medal from the Society of Naval Architects and Marine Engineers for outstanding scientific accomplishment in ship research. In addition to the foregoing awards, he received the 1931 Gold Medal from the North East Coast Institution of Engineers and Shipbuilders, Newcastle upon Tyne, for work in ship vibration; premiums of the Royal Institution of Naval Architects, London, and the Institution of Engineers and Shipbuilders in Scotland; and two medals from the Swedish Engineering Society for his work on vibration, methodical series powering experiments with models, and the seagoing qualities of ships. He was elected a fellow of the Society of Naval Architects and Marine Engineers in 1967 and an honorary member for life in 1968.

Dr. Todd was a past vice-president of the Royal Institution of Naval Architects. He was also an active participant in two main scientific associations concerned with hydrodynamic and ship research of towing tanks: the International Towing Tank Conference, of which he served as president from 1960 to 1962, and the American Towing Tank Conference, of which he was chairman from 1953 to 1956. He served the Society of Naval Architects and Marine Engineers on seven technical committees, was a member of the Council, and served on the technical committee for the 1968 Diamond Jubilee International Meeting.

Following a long and most distinguished engineering career, Dr. Todd returned to his native country, where he and his wife enjoyed several years of retirement. He felt that he had served his profession well and could devote the remaining years of his life to his family. He was preceded in death by his wife, Margaret Elizabeth (née Wilson), and one daughter, M. Allison Todd. He is survived by a daughter, Dr. Jean E. Todd of Chevy Chase, Maryland.

APPENDIX

Members	Elected	Born	Deceased
Isaac L. Auerbach	1974	October 9, 1921	December 24, 1992
Walter C. Bachman	1967	December 24, 1911	March 1, 1991
Horace Smart "Bud" Beattie	1976	July 19, 1909	September 6, 1993
Melvin Bobo	1991	February 13, 1924	October 27, 1993
Ray H. Boundy	1967	January 10, 1903	November 19, 1992
Raymond F. Boyer	1978	February 6, 1910	February 23, 1993
John Valentine Breakwell	1981	December 6, 1917	April 16, 1991
Solomon Jan Buchsbaum	1973	December 4, 1929	March 8, 1993
Dayton H. Clewell	1976	December 15, 1912	November 11, 1992
Robert L. Coble	1978	January 22, 1928	August 27, 1992
John H. Dessauer	1967	May 13, 1905	August 12, 1993
Howard Davis Eberhart	1977	August 16, 1906	July 18, 1993
James Cornelius Elms	1974	May 16, 1916	May 7, 1993
John S. Forrest	1979	August 20, 1907	November 11, 1992
A. Pharo Gagge	1979	January 11, 1908	February 13, 1993
Frederick W. Garry	1982	July 12, 1921	February 10, 1993
Robert F. Gilkeson	1978	June 26, 1917	March 13, 1993
Charles P. Ginsburg	1973	July 20, 1920	April 9, 1992
Edward L. Glaser	1977	October 7, 1929	December 5, 1990
Peter Haasen	1981	July 21, 1927	October 18, 1993
Lawrence R. Hafstad	1968	June 18, 1904	October 12, 1993
Albert C. Hall	1970	June 27, 1914	September 14, 1992
W. Lincoln Hawkins	1975	March 21, 1911	August 20, 1992
John F. Kahles	1984	September 11, 1914	May 26, 1993
Joseph Kestin	1982	September 18, 1913	March 16, 1993
Edwin Herbert Land	1965	May 7, 1909	March 1, 1991
Inge Martin Lyse	1981	October 22, 1898	December 2, 1990
Herbert G. MacPherson	1978	November 2, 1911	January 26, 1993
Paul W. Morgan	1977	August 30, 1911	May 28, 1992
Allen Newell	1980	March 19, 1927	July 19, 1992
Brian O'Brien	1981	January 2, 1898	July 1, 1992
Clarkson H. Oglesby	1989	November 9, 1908	August 23, 1992
Klaus Oswatitsch	1982	March 10, 1910	August 1, 1993
Alfred L. Parme	1974	April 5, 1909	June 28, 1992
Eduard C. Pestel	1981	May 29, 1914	September 19, 1988
Henry J. Ramey, Jr.	1981	November 30, 1925	November 19, 1993
Gordon G. Robeck	1980	February 3, 1923	February 21, 1993

Members	Elected	Born	Deceased
Henry A. Schade	1973	December 3, 1900	August 12, 1992
Galen B. Schubauer	1980	July 7, 1904	November 24, 1992
Ralph A. Seban	1978	May 11, 1917	June 13, 1993
Levering Smith	1965	March 5, 1910	April 5, 1993
Monroe Edward Spaght	1969	December 9, 1909	June 27, 1993
Eric E. Summer	1985	December 17, 1924	January 19, 1993
Richard Henry Tatlow III	1967	May 27, 1906	July 1, 1993
Frederick Henry Todd	1965	January 6, 1903	August 20, 1992

ACKNOWLEDGMENTS FOR THE PHOTOGRAPHS

ISAAC L. AUERBACH, by Drexel University, Philadelphia, Pennsylvania

WALTER C. BACHMAN, by Blackstone-Shelburne, New York

JOHN VALENTINE BREAKWELL, courtesy of the News and Publications Service, Stanford University, Stanford, California

HOWARD DAVIS EBERHART, by Ed Kirwan Graphic Arts, Berkeley, California

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KLAUS OSWATITSCH, by Photograph Kobé, Vienna, Austria

EDUARD C. PESTEL, by Studio für Werbung Mode Journalistische Illustration Photographie Joachim Giesel, Hannover, Germany

GORDON G. ROBECK, by Keller Studio, Cincinnati, Ohio

HENRY A. SCHADE, by Ed Kirwan Graphic Arts, Berkeley, California

MONROE EDWARD SPAGHT, by Shell Photographic Service, Shell Centre, London, England

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