NATIONAL MEDALS OF SCIENCE AND TECHNOLOGY MARK WORK IN PHYSICS

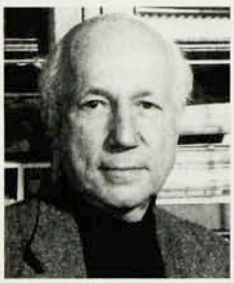
In October, President Bush presented the National Medals of Science and National Medals of Technology for 1989. At a ceremony in the East Room of the White House, 27 scientists and engineers received the medals, which are the highest science and technology honors given by the US government.

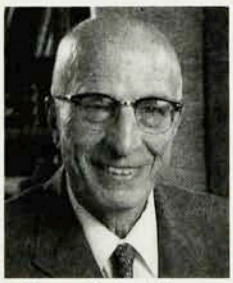
Arnold O. Beckman, founder and chairman of Beckman Instruments, was honored with a medal of science for his "leadership in the development of analytical instrumentation, and for his deep and abiding concern for the vitality of the nation's scientific enterprise." Beckman received his PhD in photochemistry in 1928 from the California Institute of Technology, where he was an assistant professor of chemistry until 1940. While still at Caltech, Beckman founded a company to produce a pH meter he had invented. Beckman Instruments is currently one of the main producers of instrumentation for chemical analysis, health care and the life sciences.

Richard B. Bernstein, professor of chemistry at the University of California, Los Angeles, was awarded the medal of science for his "development and use of the technique of molecular beams, which has played a significant role in shaping the field of modern chemical dynamics." Bernstein received his PhD in chemistry in 1948 from Columbia University. His pioneering role in the field of molecular-beam scattering began with his work on elastic scattering and intermolecular forces at the University of Michi-


Arnold O. Beckman

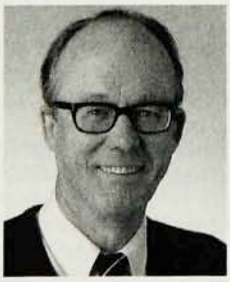

Richard B. Bernstein


Melvin Calvin


Harry G. Drickamer


Herbert E. Grier


Rudolph A. Marcus


Harden M. McConnell


Eugene N. Parker

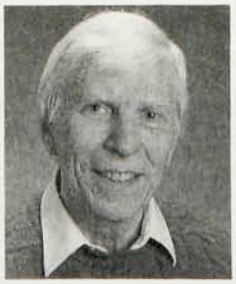

Robert P. Sharp


Henry M. Stommel


Helen Edwards


Richard Lundy


J. Richie Orr


Alvin Tollestrup

gan, where he was on the faculty from 1953 to 1963. In the 1960s, as the W. W. Daniells Professor of Chemistry at the University of Wisconsin, Madison, Bernstein devised a methodology for obtaining detailed differential cross sections for inelastic and reactive scattering events. Perhaps his most significant achievement was the development, in 1965, of the oriented-molecule beam method for the study of steric effects in gas–gas and gas–surface collisions. Bernstein employs this method in his current research on the orientation dependence of molecule–surface scattering. He has been on the faculty of UCLA since 1983.

Melvin Calvin, University Professor of Chemistry at the University of California, Berkeley, won the medal of science for his "pioneering studies in the mechanism of photosynthesis and bioenergetics, and for the application of scientific theory toward the solution of the most fundamental problems of the age—energy, food, chemical and viral carcinogenesis, and the origin of life." Calvin received the Nobel Prize in Chemistry in 1961 for elucidating the detailed path of carbon in photosynthesis, using radioactive carbon as a tracer. Calvin has also studied the detailed physical processes of photon capture and storage in photosynthesis. More recently, these studies have led him to attempt to devise artificial systems that can use sunlight to dissociate water into hydrogen and oxygen. During the oil crisis in the 1970s Calvin was active in research on the use of green plants as a renewable energy source.

Calvin received his PhD in chemistry from the University of Minnesota, Minneapolis, in 1935. After two years of postdoctoral research in England, he joined the Berkeley faculty in 1937. For 35 years Calvin was director of the chemical biodynamics division of Lawrence Berkeley Laboratory.

Harry G. Drickamer, professor of chemical engineering, chemistry and physics at the University of Illinois, Urbana–Champaign, received the medal of science for his "discovery of the 'pressure tuning' of electronic energy levels as a way to obtain new and unique information on the electronic structure of solids." Drickamer uses pressure-tuning spectroscopy, in which the energies of electronic orbitals of atoms and molecules are perturbed by varying the external pressure to study their electronic and vibrational properties. Drickamer's technique is now used by many chemists and physicists to relate bulk properties to molecular properties; to characterize local interactions in liquids, crystals, polymers and glasses; and, occasionally, to establish new ground states with properties unlike those of the same substances at ordinary pressures.

Drickamer received his PhD in chemical engineering from the University of Michigan in 1946. The same year he accepted a position as an assistant professor of chemical engineering at the University of Illinois. He became a professor there in 1953.

Herbert E. Grier, director of the CER Corporation in Las Vegas, Nevada, was awarded the medal of science for his "pioneering scientific contributions and his leadership role in ultrahigh-speed electronic stroboscopy," as well as for his innovations in electro-optics and his work in national defense and in aerospace sciences. While working toward his master's degree in electrical engineering at MIT, Grier joined Harold Edgerton and Kenneth Germeshausen in a partnership to work on ultrahigh-speed photography and to develop stroboscopic and flash lighting techniques. During World War II, the three did research on the use of electronic-flash photography for aerial reconnaissance. In 1947 they incorporated their business as EG&G Inc, of which Grier was the first president. The company has designed, built and operated the timing and firing equipment for almost every nuclear test blast in Nevada and the Pacific, as well as the equipment used to record these events.

From 1965 to 1976 Grier was president of CER Geonuclear Corp, which EG&G, Continental Oil and others founded to develop commercial applications of nuclear explosive technology, particularly applications involving the extraction of natural resources.

Rudolph A. Marcus, the Arthur Amos Noyes Professor of Chemistry at the California Institute of Technology, was honored with a medal of science for "fundamental, far-reaching and eminently useful developments of theories of unimolecular reactions and of electron transfers in chemistry and biochemistry." By combining the so-called RKK theory with more modern transition-state theory, Marcus obtained an expression, now known as RRKM theory, relating the lifetime of a molecule to its molecular properties and to the properties of the transition state for unimolecular dissociation and rearrangement reactions. In 1956 he derived expressions for the fluctuations of the electric dipoles of the

solvent molecules in the vicinity of molecules undergoing an electron-transfer reaction. His theory has been applied to a variety of electron-transfer processes, including inorganic and organic reactions in solution, biological processes and reactions at electrodes.

Marcus earned his PhD in physical chemistry from McGill University in 1946. He joined the chemistry faculty at the Polytechnic Institute of Brooklyn in 1951, and in 1964 left to become a professor of physical chemistry at the University of Illinois, Urbana–Champaign. In 1978 Marcus joined the faculty at Caltech.

Harden M. McConnell, the Robert Eckles Swain Professor of Chemistry at Stanford University, received a medal of science for "seminal contributions in developing the power of nuclear and electron magnetic resonance spectroscopy," for "the introduction of the spin-labeling technique . . . and for original discoveries on the structure, properties and functioning of cell membranes." In his early work McConnell demonstrated that the nuclear hyperfine interactions in aromatic free radicals could be used to measure the spin density in the carbon atoms of unsaturated hydrocarbons. In the mid-1960s, he and his coworkers introduced spin labeling, a technique in which a paramagnetic organic free radical is selectively attached to molecules of biological interest and used to study the motion of those molecules. McConnell's current research is on the biophysics of immune recognition.

McConnell received his PhD in chemistry from the California Institute of Technology in 1951. He returned to Caltech as a faculty member in 1956. In 1964 McConnell joined Stanford's chemistry department, of which he is currently chairman.

Eugene N. Parker, the S. Chandrasekhar Distinguished Service Professor of Physics and Astronomy at the University of Chicago, won the medal of science for "his fundamental studies of plasmas, magnetic fields and energetic particles on all astrophysical scales; for his development of the concept of solar and stellar winds; and for his studies on the effects of magnetic fields on the solar atmosphere." Parker studies astronomical phenomena, many involving both fluid dynamics and magnetic effects, that are unknown on the small scales of the terrestrial laboratory. In the late 1950s Parker realized that Sidney Chapman's demonstration that the solar corona extends far beyond the Earth contradicted Ludwig Bier-

NEW OPTICS TITLES

Laser Handbook

Volume 6:

Free Electron Lasers

edited by **W.B. Colson, C. Pellegrini** *and* **A. Renieri**

1990 about 625 pages
ISBN 0-444-86953-0
In preparation

The interplay between electric magnetic and the photon field have an intrinsic beauty and are deeply rooted in the fundamental understanding of nature. In this volume, edited by three major initiators in the field and containing contributions from experts belonging to the most advanced groups working on the subject, a first, comprehensive account of the Free Electron Laser is given. Chapters include both complete classical and quantum mechanical descriptions. Various types of experiments with intrinsic strong points and weaknesses are described while attention is also given to state-of-the-art experiments.

This book is not intended as a catalogue of on-going experiments, nor is it an attempt to prove that Free Electron Lasers are possible. It is the first large scale reference source from which all further publications on Free Electron Lasers will be based. It will therefore be indispensable for theorists and experimentalists interested in the fundamental aspects of these types of lasers.

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edited by
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(North-Holland Delta Series)

1990 viii + 324 pages
US $89.75/Dfl.175.00
ISBN 0-444-88529-3

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Volume XXVIII

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mann's hypothesis that the solar system was filled with particulate radiation from the Sun. Parker began doing simple fluid dynamics calculations to model the Sun's corona and found that the only way he could achieve a steady-state solution for which the pressure vanished at infinity was to introduce an acceleration term. In the early 1960s satellite observations confirmed that, consistent with Parker's calculations, the solar corona has greater velocities at larger distances from the Sun, so that by the time it reaches the Earth's atmosphere it is a "solar wind," moving faster than 300 km/sec.

Parker earned his PhD in physics from the Caltech in 1951. He joined the faculty of the University of Chicago in 1955.

Robert P. Sharp, professor emeritus of geology at Caltech, won a medal of science for "research that has illuminated the nature and origin of the forms and formation processes of planetary surfaces and for teaching two generations of scientists and laymen to appreciate them." Also noted were "his recruitment and leadership of a successful multidisciplinary department of Earth and planetary scientists who have gained world recognition." Sharp has studied surface processes on the Earth, many involving the interactions of the land with water, ice and wind. In experiments on the Mariner missions to Mars, he explored the surface features of that planet. His recent research interests have been glaciology, glacial history, volcanism and processes caused by wind.

Sharp received his PhD in geology from Harvard University in 1938. That same year, he joined the geology faculty at the University of Illinois. In 1947, after a two-year stay at the University of Minnesota, Sharp became a professor in the division of geological sciences at Caltech. He was chairman of the division from 1952 to 1968.

Henry M. Stommel, senior scientist at Woods Hole Oceanographic Institution, received the medal of science for his "original, penetrating and fundamental contributions to the physics of ocean circulation." In the 1940s, faced with the nearly total absence of any theory of ocean currents, Stommel began applying basic dynamics methods to simplified ocean models. In 1947 his efforts yielded the first theory of the Gulf Stream. Stommel went on to conduct a series of studies of deep-ocean circulation in collaboration with Arnold Arons. Their research produced a method for determining the patterns of abyssal ocean currents from basic principles alone. Stommel also initiated several programs to gather statistics on ocean variability.

Stommel came to Woods Hole in 1944, two years after receiving his BS in physics from Yale University. In 1959 he became a professor of oceanography at MIT, where he remained, except for a three-year period spent at Harvard University, until returning to Woods Hole in 1978.

The winners of the National Medals of Technology included four scientists who worked on the Tevatron accelerator at the Fermi National Accelerator Laboratory: Helen Edwards, now technical director of the Superconducting Super Collider; Richard Lundy, now self-employed; J. Richie Orr, associate laboratory director for administration at Fermilab; and Alvin Tollestrup, cospokesman of the Collider Detector Facility. The four were recognized for "their contributions to the design, construction and initial operation of the Tevatron particle accelerator." The citation said that "the innovative design and successful operation of the Tevatron has been crucial to the design of the Superconducting Super Collider."

As deputy head of the accelerator division and deputy project manager for the Tevatron, Edwards, in addition to her role as a key member of the design team, led the installation, assembly, testing and commissioning of the Tevatron. As manager of the magnet assembly facility for the Tevatron, Lundy supervised the engineering and testing of the machine's 1000 superconducting magnets. Orr was head of the accelerator division and served as project manager for the Tevatron, coordinating its simultaneous design and construction. Tollestrup, who was manager of research and development for the project, solved many problems pertaining to materials properties, component assembly and the precision measurement of magnet performance.

Edwards received her PhD in physics from Cornell University in 1966 and began working at Fermilab in 1970. She joined the SSC Laboratory in January 1989. Lundy earned his PhD in physics from the University of Chicago in 1962. He was a physicist at Argonne National Laboratory until 1971, when he joined Fermilab. Orr received his doctorate in physics from the University of Washington in 1965. He was an assistant professor of physics at the University of Illinois, Urbana–Champaign, until 1970, when he came to Fermilab. Tollestrup did his doctoral work in physics at Caltech, where he joined

the faculty in 1953. He came to Fermilab in 1977.

OSA AWARDS GIVEN FOR OUTSTANDING WORK IN OPTICS

The Optical Society of America each year recognizes individuals who have made noteworthy contributions to optics. The following people won awards in 1989 and 1990.

The 1990 Frederic Ives Medal, OSA's oldest and most prestigious award, will go to Joseph W. Goodman, a professor of electrical engineering at Stanford University, "for his outstanding technical contributions to the field of coherent optics and for his equally important and continuing contributions to modern optics education and to scientific communication." Goodman specializes in optical signal and image processing and has also worked in holography, theory and applications of laser speckle, design of novel imaging systems, and optical interconnections and switching.

Goodman received his PhD in electrical engineering from Stanford University in 1963. Shortly thereafter he joined the faculty as a research associate, and in 1972 he became a professor of electrical engineering. In 1988 he became department chair and the William E. Ayer Professor of Electrical Engineering.

The 1989 Ives Medal recipient was C. Kumar N. Patel, executive director of research, materials science, engineering and academic affairs at AT&T Bell Laboratories in Murray Hill, New Jersey. Patel was awarded the medal "in recognition of his illustrious career in optics and materials sciences and his exemplary service in scientific management." In 1964 Patel invented the carbon dioxide laser, and in the late 1960s he and his colleagues invented the spin-flip Raman laser. Recently he applied an optoacoustic method that he had developed in the 1970s to measure small optical absorptions in liquids, solids, thin films and powders.

Patel earned his PhD in electrical engineering from Stanford University in 1961, after which he joined the technical staff at Bell Labs. He has held a number of research management positions there (see PHYSICS TODAY, March 1988, page 53). Patel assumed his current position in 1987.

Samuel L. McCall, also of AT&T Bell Labs in Murray Hill, is the 1990 winner of the Max Born Award, which recognizes achievements in physical optics. McCall is cited for