

GEOPHYSICAL UNION SALUTES EXCELLENT WORK IN THE FIELD

The American Geophysical Union presents several awards each year in recognition of outstanding achievements in geophysics. In 1989, AGU presented its oldest and most prestigious award, the William Bowie Medal, to Walter H. Munk of the Scripps Institution of Oceanography. The Bowie Medal is given for contributions to fundamental geophysics and for cooperation in research.

In addition to the Bowie Medal, the Geophysical Union presented several other medals in 1989. The Macelwane Medal, which recognizes outstanding work by young researchers, went to Seth A. Stein and Richard G. Gordon, both of Northwestern University. The John Adam Fleming Medal for research in geomagnetism, atmospheric electricity and aeronomy was awarded to Donald A. Gurnett of the University of Iowa. The biennial Charles A. Whitten Medal for research on the form and dynamics of the Earth and other planets was presented to James C. Savage of the US Geological Survey. A. G. W. Ca-

Walter H. Munk



meron of Harvard University received the Harry H. Hess Medal, which is awarded every other year for research on the constitution and evolution of the Earth and other planets. The 1989 Maurice Ewing Medal, awarded jointly by AGU and the US Navy for research in marine geophysics, went to Klaus Wyrski of the University of Hawaii. Arthur H. Lachenbruch of the US Geological Survey received the Walter H. Bucher Medal, which honors outstanding research on the Earth's crust.

Munk's Bowie Medal citation noted that his work in oceanography marked the "beginning of a new era in our science by the combined use of satellite observations of the sea surface, acoustic measurements beneath the surface... of the ocean, and sophisticated computer modeling." His research has included work on tides, ocean circulation and long waves, and problems associated with the Earth's rotation. For the past decade, Munk has been studying ocean acoustics, and he recently proposed

Hannes Alfvén



using underwater sound transmission to measure changes in world ocean temperatures resulting from the greenhouse effect.

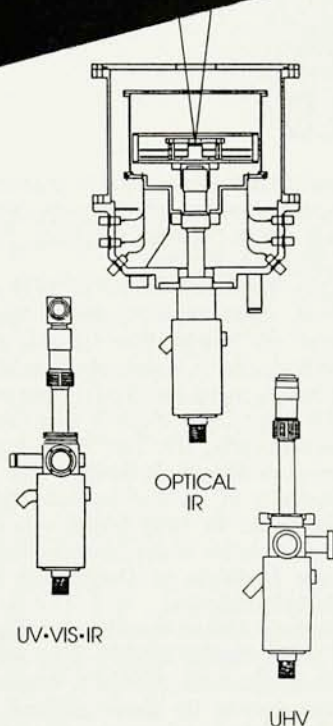
After receiving his BS in 1939 and MS in 1940 from Caltech, Munk served in World War II studying conditions for amphibious landings. In 1947 he earned his PhD in oceanography from the Scripps Institution of Oceanography. He has been a geophysics professor at Scripps and the University of California, San Diego, since then. In 1959 Munk was also named director of the La Jolla branch of the Institute of Geophysics and Planetary Science.

Hannes Alfvén was the recipient of the 1988 Bowie Medal. The award citation praised Alfvén's extensive achievements in space physics, including the discovery of hydromagnetic waves—now also known as Alfvén waves. It noted that Alfvén was a pioneer in the development of magnetohydrodynamics and was the first to suggest the role of solar winds in forming comet tails. The citation

Robert N. Clayton



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called Alfvén "one of the most original minds of our era and one of the greatest space physicists of all time."

Alfvén received his PhD from the University of Uppsala in 1934, after which he became a researcher at the Nobel Institute for Physics in Stockholm. He currently holds professorships at the Royal Institute of Technology in Stockholm and the University of California, San Diego.

Robert N. Clayton of the University of Chicago received the Bowie Medal in 1987. According to the award citation, Clayton's research has enabled geophysicists to apply the principles of modern geochemistry to matter from other parts of the Galaxy. It praised his "ingenious" use of stable isotopes in the study of the chemical history of the Earth, the Moon and meteorites, and in particular his 1973 discovery of oxygen isotope anomalies in meteorites, "which produced major new insights into the nuclear and chemical history of the solar system."

Clayton received his BSc and MS from Queen's University in Ontario, Canada, and his PhD in chemistry from Caltech in 1955. In 1958, after holding positions at Caltech and Pennsylvania State University, he joined the faculty of the University of Chicago, where he is currently a member of the Enrico Fermi Institute and the Enrico Fermi Distinguished Service Professor in the geophysical sciences and chemistry departments.

Seth A. Stein, one of this year's Macelwane medalists, was described in the award citation as "a leader in using earthquake seismology to investigate plate tectonic processes." His research includes work on subduction zones and Caribbean plate motion. Stein received his BS from MIT in 1975 and his PhD in geophysics from Caltech in 1978. In 1979 Stein joined the geological sciences department of Northwestern University, where he is currently a professor and the department chair. Stein was until recently editor of the *Journal of Geophysical Research*.

The Macelwane citation presented to Richard G. Gordon praised his "original and important" research contributions in plate tectonics and paleomagnetism. Gordon received his BS in 1975 from the University of California, Santa Cruz, and his MS and PhD in geophysics from Stanford in 1977 and 1979, respectively. In 1980 Gordon moved to Northwestern, where he is now an associate professor in the geological sciences department. His research focuses on the kinematics of the Earth's lithosphere, in particular, the study of paleomagnetic data to understand past plate

motions and to determine whether or not there has been true pole wandering over geological time.

In addition to their individual research, Gordon and Stein have worked jointly on developing a quantitative global model for present-day plate motion, called NUVEL-1. The citation presented to Gordon called NUVEL-1 a "superior model of global plate motions for the past three million years that . . . seems certain to set the standard for years to come."

In 1988 AGU presented Macelwane Medals to Marcia K. McNutt, Douglas R. MacAyeal and Kevin B. Quest (see *PHYSICS TODAY*, November 1988, page 104).

In 1987 Macelwane Medals were awarded to J. Leslie Smith of the University of British Columbia, Mary Lou Zoback of the US Geological Survey and Toshio Terasawa of Kyoto University.

The award citation presented to Smith called him "one of the most creative and innovative researchers in the field of hydrogeology." Smith's research has included the analysis of groundwater flow and solute transport in heterogeneous geologic media and work on heat transport in the upper crust as effected by groundwater flow. Smith received his BS in 1974 from the University of Alberta and his PhD in 1978 from the University of British Columbia. He was a professor at the University of Utah until 1981, when he joined the University of British Columbia faculty as a professor of geological sciences.

Zoback, a researcher with the US Geological Survey, studied at Stanford University, where she received her BS in 1974, MS in 1975 and PhD in geophysics in 1978. She has been with the US Geological Survey since 1979. Zoback and her husband, Mark, collaborated on creating the first stress map of the United States, in which stress provinces are shown to be closely and quantitatively related to tectonic provinces. Zoback is currently leading an international effort to create a world stress map, which should yield new insights into the physics of plate tectonics and intraplate deformation, the award citation said.

The Macelwane citation presented to Terasawa hailed him as "possibly the leading young theorist in the present generation of space plasma physicists" and noted his work on the plasma analyzer aboard the spacecraft *Suisei*, which observed Comet Halley in March 1986. Terasawa is currently an associate professor at the Geophysical Institute of Kyoto University. He received his DSc from

the University of Tokyo in 1978.

The 1989 Fleming Medal citation presented to Donald A. Gurnett called him "a leader in the experimental study of waves in space plasmas." It praised his invention of new ways to measure *in situ* concentrations of electrons and ions through wave-particle resonances observed using a plasma-wave instrument.

In accepting the award, Gurnett recalled that his interest in space research was first kindled by the 1958 discovery of Earth's radiation belts by James A. Van Allen, who later served as his thesis adviser. Gurnett received his BS in 1962, MS in 1963 and PhD in physics in 1965 from the University of Iowa, where he is now a professor of physics.

Michael W. McElhinny received the Fleming Medal in 1988. The citation noted that McElhinny has had a long and varied career in teaching, research and government. His research has included plate tectonics of the Paleozoic and Precambrian periods and the history and origin of Earth's magnetic field. His textbook *Paleomagnetism and Plate Tectonics* (Cambridge University Press, 1973) is still widely read and cited.

McElhinny was a professor at the Australian National University from 1967 to 1982, and served as chief of geophysics at the Bureau of Mineral Resources of Australia from 1982 to 1988. Last year he and his wife, Jo, began a two-year project of compiling a global paleomagnetic data base, work which is funded by research agencies in seven different countries. He studied at Rhodes University in South Africa, where he received his BSc with honors in physics in 1953 and his doctorate in ionospheric physics in 1958.

The 1987 Fleming Medal was given to David R. Bates of Queen's University in Belfast, Northern Ireland. The award citation praised Bates's "trail-blazing contributions to our understanding of atomic and molecular processes in the ionosphere." It noted his career-long research on factors influencing the composition of the atmosphere, including short-lived photochemical products such as ozone as well as longer-lived gases such as carbon monoxide, methane and nitrous oxide.

Bates was educated at Queen's University, Belfast, and University College, London, where he received his PhD. During World War II he did military research for Britain's Admiralty Research Laboratory. He was a lecturer in mathematics and then a reader in physics at University Col-

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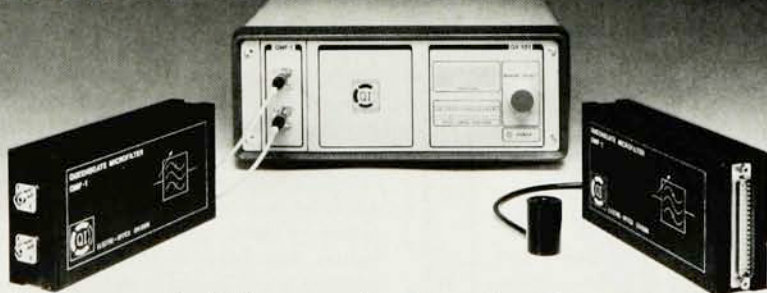
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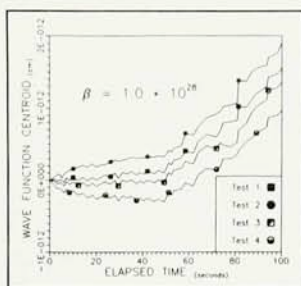


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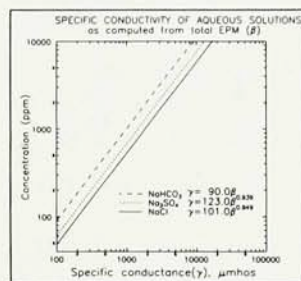
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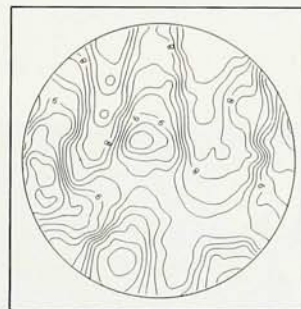
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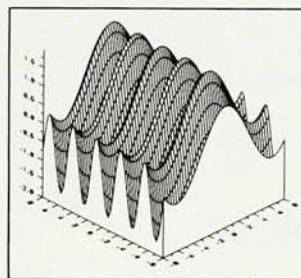
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lege from 1945 to 1951, when he accepted the chair of applied mathematics at Queen's University.

James C. Savage, a researcher at the US Geological Survey, received the 1989 Whitten Medal for work that the award citation said "more than anything else has made the observation and analysis of geodetically measured crustal deformation one of the preeminent disciplines in earthquake research." The citation mentioned that Savage's research has led to a faster and more precise system for detecting crustal movement, which uses laser-ranging technology as well as airborne measurements. This approach has been used to map most of the seismically active portions of the western United States and Alaska.

Savage received his BS from the University of Arizona in 1950 and his PhD in geophysics from Caltech in 1957. He held faculty positions at the University of British Columbia and the University of Toronto before joining the Geological Survey in 1969.

In 1987 William M. Kaula of the University of California, Los Angeles, received the Whitten Medal. The award citation noted that Kaula's book *Theory of Satellite Geodesy* (Blaisdell Publishing Company, 1966) was important in giving "a systematic, logical development of the satellite orbit problem" and was useful for designing satellite geodetic research programs. "There is a generation of scientists and engineers who, when considering a problem in satellite geodesy, automatically think in terms of [Kaula's] mathematical formalisms," the citation stated.

Kaula received his BS from the US Military Academy at West Point in 1948 and his MS from Ohio State University in 1953, while still serving in the Army. After leaving active military duty in 1957, Kaula joined the Army Map Service. From 1960 to 1963 he worked at NASA's Goddard Space Flight Center. Since then, Kaula has been a professor of geophysics at UCLA's Institute of Geophysics and Planetary Physics. His research has included the dynamics of solar system origin and evolution and the thermal and tectonic evolution of terrestrial planets.

A. G. W. Cameron was presented with the biennial Hess Medal for his "extraordinary pioneering contributions to the theory of nuclear synthesis in the development of the solar nebula... and [in] the formation of the Sun, the planets, the Moon and the comets." In trying to understand the formation of the solar system, Cameron simultaneously considered astrophysical, dynamical and chemi-

cal aspects, the citation stated.

Cameron received his BSc in 1947 from the University of Manitoba and his PhD in physics from the University of Saskatchewan in 1952. Since 1973 he has been on the faculty of Harvard University, where he is now a professor of astronomy. Prior to that, he held positions at Yeshiva University, the Goddard Institute of Space Studies and Atomic Energy of Canada Ltd. Cameron headed the National Academy of Sciences Space Science Board from 1976 to 1982, a time when the board was laying out guidelines for planetary exploration and astrophysical programs.

In 1987 the Hess Medal went to Julian R. Goldsmith of the University of Chicago. Goldsmith's research has included the study of mineral substances such as carbonates and feldspars and of processes such as mineral phase equilibria and phase transition kinetics, particularly at high pressures. His latest work demonstrates the role of small quantities of hydrogen in accelerating mineral reactions in anhydrous systems at high pressure. Such behavior parallels that of certain classes of substances deep in the Earth.

Goldsmith received his BS in 1940 and his PhD in geology in 1947 from the University of Chicago, where he is now the Charles E. Merriam Distinguished Service Professor emeritus of geochemistry.

The 1989 Ewing Medal was presented to Klaus Wyrtki. The award citation praised his research which has produced "a better understanding of the role of the ocean in climatic change on Earth." Wyrtki's work has focused on physical oceanography in the tropics; his paper "El Niño: The Dynamic Response of the Equatorial Ocean to Atmospheric Forcing" (*Journal of Physical Oceanography*, 1975) has stimulated much scientific debate and is widely cited, the citation noted.

After studying mathematics and physics at the University of Marburg, West Germany, Wyrtki went to the University of Kiel, where he received his PhD in physical oceanography in 1950. He then held various positions in Germany, Indonesia, Australia and Monaco before moving to the Scripps Institution of Oceanography in 1961. Wyrtki has been a professor of oceanography at the University of Hawaii since 1964.

The 1988 Ewing Medal was presented to Wolfgang H. Berger of the Scripps Institution. The citation stated that "the collection of [Berger's] ideas and thoughts... has shaped or created most of our important concepts in paleoceanography." His re-