Memorial to Maurice Ewing
1906-1974

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On April 28, 1974, in Galveston, Texas, Maurice Ewing suffered a massive cerebral hemorrhage and was rushed to the John Sealy Hospital where he passed away on May 4. The stroke occurred without warning while he was at a new peak in his professional career and immensely enjoying his new life in Galveston. While his family has suffered the greatest loss, his colleagues, students, and the world of science have suffered a loss only slightly less severe.

A memorial service was held in Galveston at the Trinity Episcopal Church where Dr. Frank Press, a former student and close associate, presented a very touching eulogy. He was buried after a service in Sparkill, New York, on May 8, 1974, attended by more than 300 people, many of whom left important duties and came great distances to be present.

Born in Lockney, Texas, on May 12, 1906, to Hope Hamilton Ewing and Floyd Ford Ewing, he was named William Maurice Ewing. Brought up in the Panhandle of Texas, where he attended to many farming chores and achieved his first love of the earth, he received a well-disciplined upbringing that instilled in him the high moral values he exhibited throughout his life.

He received his B.A. in 1926 with honors in mathematics and physics, his M.A. in 1927 in physics, and his Ph.D. in 1931 from Rice Institute (now Rice University) where he was Hohenthal Scholar from 1923 to 1926 and a Fellow in physics from 1926 to 1929. In the summers, he worked in the oil patch, gaining invaluable experience and friends.

He served as instructor of physics from 1929 to 1930 at the University of Pittsburgh. At Lehigh University he was instructor from 1930 to 1936, assistant professor of physics from 1936 to 1940, and associate professor of geology (on leave of absence) from 1940 to 1944. It was here, through the persuasive voices of William Bowie, Walter Bucher, and Everett De Galyer, that he was introduced to the sea and his lifelong work.

Through the war years of World War II, 1940 to 1946, as research associate at the Woods Hole Oceanographic Institution, he led a large team carrying out acoustical and optical research of great importance to the U.S. Navy. In 1944, he accepted an appointment at Columbia University. He served as associate professor of geology from 1944 to 1947, professor of geology from 1947 to 1959, Higgins Professor of Geology from 1959 to 1972, Higgins Professor Emeritus of Geology from 1972 to 1974, founding

director of the Lamont-Doherty Geological Observatory from 1949 to 1972, and senior research associate of the observatory from 1972 to 1974.

In 1972 he moved to the University of Texas Medical Branch in Galveston, Texas, where he became the founding chief of the Earth and Planetary Sciences Division of the Marine Biomedical Institute, as well as the Cecil H. and Ida Green Professor of Marine Sciences and Adjunct Professor of Geology of Rice University from 1972 to 1974.

Ewing held office as councilor of the Geological Society of America from 1946 to 1948 and as vice-president from 1953 to 1956. He was president of the American Geophysical Union from 1956 to 1959. He served the Seismological Society of America as vice-president from 1952 to 1955 and as president from 1955 to 1957. He was on the Rice University Board of Governors from 1969 to 1973, and he was vice-president of the Philosophical Society of Texas from 1973 to 1974.

He held the honorary degree of Sc.D. from Washington and Lee University, 1949; University of Denver, 1953; Lehigh University, 1957; University of Utrecht, 1957; University of Rhode Island, 1960; University of Durham, 1963; University of Delaware, 1968; Long Island University, 1969; Universidad Nacional de Colombia, 1969; Centre College of Kentucky, 1971; and the honorary degree LL.D. from Dalhousie University, 1960.

Honors heaped on him from all over the world included the following:

Guggenheim Fellow, 1938
National Academy of Sciences, Member, 1948
Geological Society of America, Arthur L. Day Medalist, 1949
American Academy of Arts & Sciences, Member, 1951
Philosophical Society of Texas, Member, 1953
Guggenheim Fellow, 1953, 1955
National Academy of Sciences, Agassiz Medal, 1955
U.S. Navy Distinguished Public Service Award, 1955
Royal Netherlands Academy of Sciences and Letters, Foreign Member (Section for Sciences), 1956
American Geophysical Union, William Bowie Medal, 1957
Argentine Republic, Order of Naval Merit, Rank of Commander, 1957
Society of Exploration Geophysicists, Honorary Member, 1957
American Philosophical Society, Member, 1959
American Institute of Geonomy and Natural Resources, Inc., John Fleming Medal, 1960
Columbia University, Vetlesen Prize, 1960
American Geographical Society, Cullum Geographical Medal, 1961
Dickinson College, Joseph Priestly Award, 1961
Rice University, Medal of Honor, 1962
National Academy of Sciences, John J. Carty Medal, 1963
Geological Society of London, Foreign Member, 1964
Royal Astronomical Society (London), Gold Medal, 1964
Swedish Society for Anthropology and Geography, Vega Medal, 1965
Academia Nacional de Ciencias Exactas, Fisicas y Naturales (Buenos Aires), Corresponding Member (New York), 1966
Third David Rivett Memorial Lecturer (C.S.I.R.O., Australia), 1967
Indian Geophysical Union, Honorary Fellow, 1967
American Association of Petroleum Geologists, Sidney Powers Memorial Medal, 1968

American Association of Petroleum Geologists, Honorary Member, 1968
Saint Louis University Sesquicentennial Medal, 1969
Geological Society of London, Wollaston Medal, 1969
Sociedad Colombiana de Geologia, Honorary Member, 1969
Royal Society of New Zealand, Honorary Member, 1970
Royal Society (London), Foreign Member, 1972
Rice University, Alumni Gold Medal, 1972
Robert Earll McConnell Award – American Institute of Mining, Metallurgical & Petroleum Engineers, 1973
Royal Astronomical Society (London) Associate, 1973
Houston Philosophical Society, Member, 1973
National Medal of Science, 1973
Canadian Society of Petroleum Geologists, Honorary Member, 1973
First Sproule Lecturer, University of Alberta, 1973
American Geophysical Union, Walter H. Bucher Medal for 1974
Distinguished Achievement Award of the Offshore Technology Conference, 1974

At the November 1974 annual meeting of the Geological Society of America, Dr. Ewing was posthumously awarded the Penrose Medal.

Maurice Ewing led a life of continuous innovation and leadership. In the early years, he made theoretical studies of refraction seismology that put the interpretation on a firm physical and mathematical footing.

In 1935, he initiated seismic refraction measurements in the open sea. Even before this work was completed, he undertook the first pendulum gravity measurements at sea in the United States, borrowing the equipment and receiving training in its use from F. A. Vening Meinesz. He introduced the use of the crystal chronometer in this work, a much needed improvement for accuracy, reliability, and ease of observation.

In the late thirties, he developed robot seismic equipment for making seismic observations on the bottom of the deep sea. Hampered by the limitation of a two weeks-per-year access to a sea-going vessel (and then only on a piggyback basis on cruises whose main objective was another purpose), he and his students, Vine, Webster, Woollard, and Worzel, were still able to obtain a few measurements of sedimentary velocities in the deep ocean before World War II intervened.

At an early date Ewing recognized that World War II would greatly affect the welfare of the United States. He took leave of absence from Lehigh University and moved his group to the Woods Hole Oceanographic Institution (WHOI) to commence defense research in September 1940, four months before the National Defense Research Corporation (NDRC) was inaugurated. Going to work immediately with Columbus Iselin and J. Lamar Worzel, he wrote the definitive manual *Sound Transmission in Sea Water*, which explained the physical and oceanographic factors that controlled underwater sound. With A. C. Vine he redesigned the bathythermograph from a clumsy, slow-recording, temperature-depth measuring device for ships hove to, to an instrument capable of measuring temperature versus depth to 600 feet deep from ships underway at 20 knots–all before NDRC was able to make a contract with WHOI to recompense the group.

Underwater photographs of the ocean bottom (a sideline to his work before the war years) was extended with underwater wreck photography, photography by divers,

and hydrofoil photography of the ocean bottom from ships underway during the war years. Meanwhile, the training of a vast number of observers in the use of the bathythermograph and in underwater sound prediction was carried out under his direction. Theoretical studies in underwater sound were continued under his direction and the use of the SOFAR channel for long-range transmission of sounds in the ocean was conceived, tested, and successfully demonstrated.

Returning to academic work at Columbia University in June 1946, he founded a research teaching group, which soon made many contributions to marine geophysics. He established an earthquake seismograph station, which became a leading, if not the leading, institution in this work in the world.

In 1949, the size of the group of students and professors and the size of the research program underway, coupled with the need for a quiet location for the seismograph station, convinced President Eisenhower and the trustees of Columbia University to accept the estate of Thomas W. Lamont and to install Dr. Ewing as the founding director of Lamont Geological Observatory.

Also, in 1949, Dr. Ewing founded the Columbia University Geophysical Field Station (SOFAR Station), which worked in conjunction with the Lamont-Doherty Geological Observatory largely on classified projects. In 1970, when Columbia University refused to continue classified projects, he, Worzel, and Gordon Hamilton, director of the Columbia University Geophysical Field Station, formed the Palisades Geophysical Institute, a nonprofit educational corporation, so that the work at Bermuda could be continued and the expertise of the staff preserved. He served as president of that corporation from its founding until his death. This organization has flourished and its staff and operations have more than doubled.

In the decades of the fifties and the sixties, he and the staff of the observatory under his direct supervision and encouragement conceived most of the techniques of observation, built the first equipment, demonstrated its use, and applied the techniques widely to the study of the World Ocean. Included among these are: continuous soundings in the deep sea, precision depth recording, seismic refraction measurements in the deep sea, ocean-bottom seismographs, long piston coring of the bottom, gravity measurements from surface ships at sea, magnetometer measurements at sea (first with a flux-gate magnetometer and later with a nuclear resonance magnetometer), underwater photography in the deep sea, reflection seismic measurements in the deep sea, reflection profiling at sea, air gun sound sources, thermal gradient measurements in conjunction with piston coring, sampling of deep water for radioactive measurements, satellite navigation, nephelometry, measurements at depth, 3.5 kHz sonoprobe measurements, seismic buoys in conjunction with continuous profiling, oriented cores from the ocean floor, integrated measurements of a number of phenomena from a single wire, and simultaneous observations in the deep sea from two wires providing an even greater integration of simultaneous studies and efficiency of station observations.

He and his colleagues wrote more than 343 papers. Some of the most important explained these techniques, interpreted results from them, identified the mid-ocean ridge as the major Earth feature after continents and oceans, demonstrated the presence of turbidity currents, showed that the tectogene was nonexistent, indicated the discovery

of the Sigsbee Knolls and many other features, explained sedimentary regimes in oceanic basins, and investigated continental margins.

In seismology he and his close associates attacked the "coda" and identified most of its components as dispersive wave trains of Love and Rayleigh waves. He and Dr. Frank Press designed a more sensitive seismograph and set up a world-wide group of stations with identical instruments which later served as a model for the World Wide Standardized Seismograph Network. Besides the numerous papers about coda, he and his close colleagues wrote many that interpreted the T phase, the coupling of air waves with seismic waves, microseisms, free oscillations of the Earth, and the variation of Earth tides across the continent. With Dr. Press and Dr. Wenceslas Jardetzky, he wrote the classic book *Elastic Waves in Layered Media.*

His work with Dr. William Donn considered oscillations of the atmosphere and included a theory for the occurrence of ice ages, involving reactions between the ocean and the atmosphere.

He served as cochief scientist on Leg 1 of the *Glomar Challenger* with Dr. Worzel. This project first proved the existence of salt domes in the deep ocean, the presence of fully developed cap rocks on these domes, and the inclusion of oil and sulphur. This was also the first proof of oil being present in the deep sea.

In the seventies, he participated in the important discoveries made by the moon seismographs.

Characteristically, he was addressing himself and his colleagues to applying 24-channel common depth point seismology developed in the oil industry to problems of the continent-ocean transition zone during his stay at Galveston. He saw the exciting results from the first line of data just before he was stricken.

Yet the achievement of which he was proudest was the great success of the more than 200 graduate students whom he had trained in his 50 years as a scholar and teacher. Some became heads of departments of Earth sciences at many universities; many were men highly placed in government agencies, such as the Office of Naval Research, the National Science Foundation, National Oceanic and Atmospheric Administration, and the Geological Survey; and others were men of importance in many industrial corporations.

Truly, he was an inspired and inspiring teacher.

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