obituary

M. Ewing

MAURICE EWING, the eminent oceanographer, died in Galveston, Texas, on May 4, 1974.

Ewing attended the Rice Institute (now Rice University) for both his undergraduate and graduate education in Physics. On receiving a Ph.D. in 1931, he was appointed to the Physics Department at the University of Pittsburgh, then at Lehigh University where William Bowie, Richard Field and Walter Bucher introduced him to the problems of seagoing geophysics. Using equipment and help from F. A. Vening Meinesz, pendulum gravity measurements at sea were begun. With his students (and lifelong associates) Vine, Webster, Woolard and Worzel, techniques were developed for making seismic measurements with the explosive source and automatic recording equipment on the seafloor. In this manner, the first marine seismic refraction measurements were attained just before the outbreak of the Second World War. Sediments were found to be thicker over the continental shelf than in the deep sea.

In 1940 Ewing took leave of absence (he was then an Associate Professor of Geology at Lehigh) to move with his group to the Woods Hole Oceanographic Institution and work on problems of submarine detection in association with Columbus Iselin, who had become impressed with the decisive role played by the thermocline in determining sound transmission characteristics in the upper ocean. Ewing and Vine adapted the Sphilhaus bathythermograph for use on vessels while underway. Iselin, Ewing and Worzel produced a manual, *Sound Transmission in Sea Water* for use in a basic training course at Woods Hole for Naval Officers. Ewing and Pekeris were the first to recognise the importance of the minimum in sound velocity for long-range sound transmission (SOFAR). The expected wave guide effect was demonstrated with a dramatic test: a small explosive was detonated at depth in the eastern Atlantic, and recorded on the western side with hydrophones suspended into the SOFAR channel. Ocean bottom photography, developed as a sideline in previous years, was applied to underwater shipwreck photography. With some incredible luck, Ewing obtained a picture of a wreck's nameplate; he would carry this in his pocket to convince sceptical Naval officers of the usefulness of underwater photography for identification purposes. The first seabottom wave recorder was built by Ewing.

In 1946 Ewing and some of his group returned to academic work—this time at Columbia University, where they soon founded the Lamont Geological Observatory (now Lamont–Doherty). Ewing served as Associate Professor of Geology, then Professor, occupying the Higgins Chair from 1959 to 1972. Under Ewing's direction, the Lamont Observatory moved into the forefront of geophysics and geology, especially as related to the oceans. Seismic refraction measurements were resumed, this time not with bottom-dropped instruments but with suspended hydrophones. Ewing developed and used towed magnetometers (first flux-gate, later nuclear precession), and initiated continuous reflection profiling with air-gun sources. He improved techniques for precision depth recording, gravity measurements (from submarines and later from surface vessels) and long piston coring, and carried out heat-flow measurements in conjunction with piston coring.

Yet another contribution was the suggestion that turbidity currents played a vital role in sedimentary processes. The study of the sedimentary evidence led to a theory (with Donn) for climatic change.

In association with Frank Press and Wenceslas Jardetsky, Ewing launched a major era of seismology with the study of surface wave dispersion, explaining many previously misunderstood features of seismograms. The book *Elastic Waves in Layered Media* by Ewing, Jardetsky and Press served as a basic text for a new generation of seismologists.

Thus, Ewing's career was one of many thrusts into the unknowns of the Earth: the Continental Shelf, submarine ridges and trenches, the structure of continents, ocean basins and the earth as a whole, the structure and origin of sediments and the structure of the oceanic water column. He certainly provided plenty of stimulating competition for other oceanographic laboratories.

The development of the theory of ocean floor spreading and plate tectonics was made possible to a great extent by the observations made by Ewing and his coworkers. The discovery of the thinness of the oceanic crust and oceanic sediments and the discovery of the continuity of the mid-oceanic ridge system were especially important keys. Ewing enthusiastically supported the JOIDES drilling programme which was to give dramatic confirmation to the concept of ocean floor spreading. He maintained a healthy scepticism for any new schemes proposed either by himself or others and the theory of the new global tectonics was no exception. He was later to comment that he was amazed to see so many of the facts that had puzzled him about the oceans explained by such a simple theory.

Ewing was a man of quiet courtesy, which belied a singlemindedness of purpose. Once the priorities were set, nothing would be permitted to get in the way. Thus, he would turn the lathe in the ship's crammed machine shop all night to replace a faulty gear. Once when swinging gravity pendulums aboard submarines, he told one of us: "If we get sub time, no matter where or when, Worzel or I will be aboard." While securing some explosives aboard the VEMA during an early morning gale, Ewing and two shipmates were washed overboard. Ewing and one man were miraculously saved but Ewing sustained injuries from which he never quite recovered. In reflecting upon his own reactions, Ewing characteristically assigned his priority: to stay afloat.

During his long and productive career, he helped train more than 200 graduate students. Affectionately known to his students as 'Doc', he expected no less from them than the hard work and devotion that he himself was always ready to give. His students and colleagues will remember the many times they stepped from his office inspired and challenged by either a few minutes or a few hours of intense interaction. He was the author of more than 300 papers and many honours came to him; among them, election to the National Academy of Sciences in 1948, the Vetlesen Prize in 1960, Foreign Membership of the Royal Society in 1972, and also the National Medal of Science in 1973.

His last two years were spent very happily as Green Professor of Marine Sciences and Founding Chief of the Earth and Planetary Sciences Division of the University of Texas Marine Biomedical Institute in Galveston.