ROCK STARS

Kenneth Orris Emery (1914–1998): Pioneer Marine Geologist

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An example of Emery's inventiveness. The purpose of this strange contraption is lost to history but may have served as a sediment trap.

Birth and Formative Years

K.O. Emery was born in Swift Current, Saskatchewan, in 1914. His father, a carpenter and contractor, was there building barracks for World War I soldiers. The family followed construction jobs across the United States to New York, Oklahoma, and Texas, where K.O., as he was universally known, picked up his Texas accent and most of his schooling through early college years. During his senior year in high school, he collected, organized, and identified Cretaceous fossils from outcrops in the Fort Worth area. In high school, he enrolled in ROTC and earned the rank of major at graduation. He chose not to continue this program to an eventual Army commission, but the experience showed his natural talent for leadership.

K.O.'s excellent academic record earned him a one-year scholarship to any college or university in Texas. However, he decided to work to earn additional funds during 1932 and 1933 as manager of the local gas station, using the time between customers to read philosophy books. He attended North Texas Agricultural College, Arlington, in 1933 and studied there for two years. In the summers of 1934 and 1935, he and a college classmate hitchhiked and "rode the rails" to see the World's Fairs at Chicago and San Diego, where they scrounged for work in restaurants to earn living expenses.

Young Emery became interested in engineering and geology and upon the recommendation of a favorite geology professor, transferred to the University of Illinois in 1935. His intent was to combine geology and engineering into a major in mining engineering. Seeking funds for living expenses, he went to the Geology Department where he met Dr. Francis Shepard, who noted Emery's drafting expertise and recruited him to go to the U.S. Coast & Geodetic Survey offices in Washington, D.C., to work on maps of seafloor bathymetry (Curray, 2001). This confirmed K.O.'s interest in marine geology. He continued under Shepard's direction after his undergraduate years, earning an M.S. and Ph.D. Shepard was shifting his work to Scripps Institution of Oceanography, and much of K.O.'s work for his doctorate was also centered at that institution. K.O. received his Ph.D. from Illinois in 1941.

The difficult years spanning the Great Depression and World War II were "sink or swim" times for an entire generation and they greatly affected Emery's development as a person and scientist. There are some interesting parallels between K.O.'s early years and those of Maurice Ewing (Wertenbaker, 2000), another Texan who also experienced the hard times of the Depression era and ultimately achieved international repute as a marine scientist. It is likely that the adaptability, initiative, and confidence to surmount any barrier—characteristics of both of these marine scientists—were a product of those tough times.

Early Career and Experiences

Emery and his best friend Robert Dietz were Shepard's graduate assistants and followed him to Scripps to become the first generation of "marine geologists" under his tutelage. The pay was poor but they managed to exist student-style in the "community house" on the old Scripps Campus with other graduate students. Shepard assigned them many tasks, one of which was to row him out on repeated trips to the Scripps and La Jolla Submarine Canyons. There, they took depth soundings using a heavy weight attached to a fishing line. K.O. would row, make the sounding, and lift the heavy weight back into the boat, while Shepard located the sounding using horizontal sextant angles between known locations on the beach. Dietz recorded the data. These studies resulted in the first detailed maps of the heads of submarine canyons. The main discovery was a great change in depth over time, showing that active marine processes were taking place.

K.O., like others in that pioneering generation, designed and built most of his own shipboard equipment to sample the seafloor. His earlier work as a mechanic in a gas station may have been a factor in his equipment-design success. His sea experience, begun in a rowboat, now progressed to the *E.W. Scripps*, a 110-foot schooner built for the Scripps Institution with support from the Scripps family. Early cruises off southern California and in the Gulf of California provided data that K.O. and Dietz used for their theses and doctoral dissertations. They worked with bathymetry and structure, seafloor sediments and rock, and phosphorite and marine clays, making discoveries that laid the basic groundwork for future marine geologists. However, geology was not the sole pursuit of these embryonic scientists. Ever the experimenter, K.O. talked Dietz into growing a mustache and

beard and proceeded to measure how long the hairs grew each week during the expedition.

The War Years

After receiving his Ph.D., Emery took a job with the Illinois Geological Survey locating water supplies for defense industries. At that time, the Navy did not perceive a need for ocean science and the survey job was the only option. A big plus during that time was his marriage to Caroline Alexander in October 1941. Caroline was an ideal partner who dedicated her life to supporting K.O.'s science work. The attack on Pearl Harbor (December 1941) and the entry of the U.S. into war pushed the Navy to recognize needs for oceanographic research and brought Emery back to the sea.

At Shepard's invitation, K.O. joined the University of California Division of War Research (UCDWR), which was formed in World War II to apply ocean science to wartime problems. K.O. made maps that identified different types of substrate on the ocean floor. Combined with the known acoustic reflectances of those substrates, the maps could aid submarines in hiding from enemy destroyers. The maps revealed a patchy distribution of sand, gravel, mud, and rock outcrops over the offshore continental margin; one of his first major scientific contributions was to explain the distribution patterns by describing the processes that formed them.

After the conclusion of World War II, Emery joined with the U.S. Geological Survey in a major study of the Pacific coral islands as a background for the atomic bomb tests at Bikini. The work led to a number of monographs with several co-authors on the characteristics of the atolls and their histories.

The Rise to International Prominence

While completing the Pacific island study, K.O. joined the geology faculty at the University of Southern California (USC) in 1946. He taught introductory physical geology, a requirement for geology and engineering students. His enthusiastic optimism and interest in everything geologic captured the imagination of all of his students, causing many engineering majors to shift to geology.

Emery continued his relationship with the Office of Naval Research while at USC and organized studies of the Persian Gulf and its shorelines for the U.S. Navy, in preparation for possible amphibious landings to protect American interests in the newly discovered oil fields there. Typically, K.O. did not miss a chance to do some geology along the way, using the continuously-recording echo-sounder aboard the USS *Pocono* to record a continuous depth profile of the Atlantic Ocean floor from Norfolk, Virginia, to the entrance of the Mediterranean.

Following the Persian Gulf expedition, and with the gift to USC of a new oceanographic research ship, the *Velero IV,* courtesy of Captain Allen Hancock, Emery entered a new phase of his career. The ship's design was based on the highly successful tuna boats which were beginning to make extended deep-sea ventures from San Diego.

The acquisition of the *Velero IV* focused K.O.'s interests on the California Borderland, the subsea region for which he had compiled bathymetric charts during his graduate work with Shepard. This major episode in his career was summarized some 15 years later in his book, *The Sea off Southern California,* which examined water, sediments, life, structure, and economic factors of the area. The book is still a primary reference for the region and a model of a complete oceanographic study. It incorporated the theses and dissertations of his graduate students, and revealed what obviously had been the master plan for his tenure at USC.

K.O. did not limit himself to the Borderland and was involved in several projects in other areas of interest. The arrival of a student from Israel, David Neef, provided access to Dr. Y.K. Bentor, the director of the Geological Survey of Israel, and Gen. M. Makleff, the director of the Dead Sea Works. Work on the Dead Sea was initiated, the necessary facilities were bought, built, and installed within a very short period, and the first cruise took place only a month after K.O. arrived in 1959.

Contributions as a Teacher

K.O.'s graduate students enjoyed close relationships with him, including occasional poker games at his home. He was a Socratic teacher, challenging students to think deeply about the lecture subjects and reading. Undergraduate students had to write term papers to develop this important skill for graduate studies and had to take the hardest classes and strive for the Bachelor of Science degree, not the Bachelor of Arts. Moulded by his strict regimen, many of his students went on to become leaders in the field of marine geology.

Culmination of His Career

In 1961, K.O. accepted an endowed chair at Woods Hole Oceanographic Institution and leadership of a large comprehensive study of the Atlantic Ocean with U.S. Geological Survey funding and other federal grants. This ten-year study was summarized in a monumental monograph, *The Geology of the Atlantic Ocean*, published in 1984 with Elazar Uchupi as coauthor. This monograph, much like the earlier book on the California Borderland, was a characteristically broad coverage of every aspect of the Atlantic, including economic resources as well as structure, sediments, water, and life of the region.

K.O. was eclectic in his choice of research. Widely varied topics included continental-shelf sediments, estuaries and marshes, beach processes, sand dunes, evaporites, lakes, and streams. K.O.'s other interests included studying the history of oceanography and collecting ocean-themed postage stamps from around the world. He wrote a paper concerning such stamps in 1960. At his death in 1998, he had just completed a manuscript on oceanography as depicted on ancient coins.

At the age of 83, K.O. wrote an autobiography that was recently published in *Marine Geology* (2002). It is a fascinating story of the career of an adventuresome bright young man who rose from inauspicious beginnings to receive the highest honors and acclaim in his profession, including membership in the National Academy of Sciences, most of the prestigious medals and fellowships in geology, and honorary degrees, including one from USC. K.O. died in Falmouth, Massachusetts, in April 1998.

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