Kenneth O. Emery

1914–1998

BIOGRAPHICAL *Memoirs*

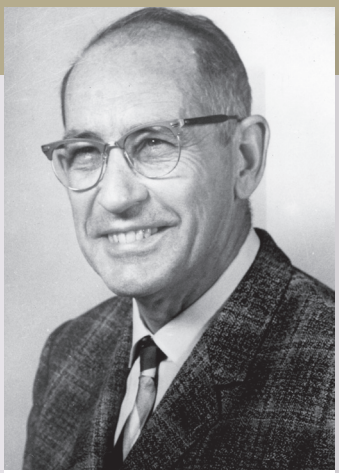
A Biographical Memoir by
David G. Aubrey

NATIONAL ACADEMY OF SCIENCES

KENNETH O. **EMERY**

June 6, 1914–April 12, 1998

Elected to the NAS, 1971



By David G. Aubrey

Kenneth O. Emery was a marine geologist whose fields of study broadly centered on his primary area of expertise, but who was driven by a curiosity that knew few scientific bounds. Having studied under the "father of marine geology," Francis P. Shepard, Emery inherited much of Shepard's love for the oceans and scientific investigation. The scale of his studies spanned vast dimensions, from ocean basins (solar system, Atlantic Ocean, offshore Southern California, Persian Gulf, Oyster Pond) to small geological features that others seem to have ignored (rims on solution basins, laminated beach sands, swashes and swash marks, rip currents, and more). Nor did he restrict himself to marine geology, but, rather, examined its interactions with economic geology, marine life, marine chemistry, archaeology, and even stamps and coins of the world. He also was a superb and ambitious synthesizer, able to take in innumerable disparate pieces of scientific research and weave them into whole cloth, examples being his studies of the Atlantic Ocean, the Southern California continental borderland, and the morphology of the rocky planets.

Emery earned a B.S. (1935), M.S. (1939), and Ph.D. (1941), all in geology and all from the University of Illinois, the latter degree including work at the Scripps Institution of Oceanography in La Jolla, California. After earning his doctorate, he did a brief stint at the Illinois Geological Survey, then spent the rest of the war years at the UC-Berkeley Division of War Research, working for the Navy on seabed acoustics and implications for submarine warfare. Following the war he began teaching geology at the University of Southern California, where he remained until 1962. He then took a position at the Woods Hole Oceanographic Institution doing marine geological research until his retirement in 1979.

Kenneth Orris Emery was born on June 6, 1914, in Swift Current, Saskatchewan, Canada. His birthplace appears prophetic to his scientific career, which was like a fast current moving through a more placid academic community of peers. His father, a carpenter and painter, moved the family serially to New York State, Oklahoma, and then Texas, where young K.O., as he was called by everybody, kept busy with a newspaper route, *Saturday Evening Post* sales, and the Boy Scouts, moving on to his father's trade as he got older. In high school K.O. was involved with the Reserve Officers Training Corps (R.O.T.C.), as well as the Citizens Military Training Corps. Although both programs would have led to a commission in the army, K.O. instead chose other career interests, using these experiences to learn leadership. It was while in high school that K.O. first developed his interest in fossils, resulting in an extensive collection he later donated to a local college.

Following high school graduation in 1932, K.O. delayed expending his award of a year's scholarship to any college in Texas, instead choosing to work first. In this interim period, he and a close friend hitchhiked and "rode the rails" to two World Fairs: one in Chicago and one in San Diego, where he worked to earn more money for college. Since this period was in the heart of the Depression, money for transportation was hard to come by, forcing K.O. to find free transport. Later K.O. was to speak of this period and his time living with homeless, jobless men who also rode the rails, as a period of great freedom and independence, experiences that were to come in handy in later college years, when he had to rely on these newfound transportation skills. When K.O. began college in 1933, his transportation mode was hitchhiking; he estimates he hitchhiked 8370 km (5200 miles) during a single school year.

K.O. studied electrical engineering at North Texas Agricultural College in Arlington, but also took geology classes. This combination led him to select mining engineering for his later study. His North Texas advisor recommended that he transfer to the University of Illinois in Champagne-Urbana, which he attended the following year, arriving via his now standard transport of hopping freight cars.

Thus the die was cast. At Illinois, K.O. worked and studied with the great Francis P. Shepard, initiating a decades-long collaboration that broadened through contacts with Shepard's other students. Shepard immediately recognized the value of the drafting abilities K.O. had learned as an engineering student, leading to their immediate collaboration on the publication of contour maps and other maps of Shepard's submarine canyon data (Shepard and Emery, 1941). To his last days, K.O. continued to do his

Dr. Emery making measurements of Oyster Pond, a coastal pond in a glacial outwash feature on the south shore of Cape Cod adjacent to his house at the time. This pond featured in a popular book written by Dr. Emery: *A Coastal Pond studied by Oceanographic Methods*.

own drafting, arguing that by drafting the materials himself he was able to present the data in the most intelligible way, while keeping control of the accuracy of the figures. For our book *Sea Levels, Land Levels and Tide Gauges* (1991), K.O. hand-drafted the majority of the figures, even though most had been computer-generated and printed on a large plotter. Attention to fine details of font, orientation, and scale that would enable readers to understand the material was of utmost importance to K.O., the consummate educator.

There may also have been a bit of cost-savings implied in K.O.'s drafting as well, since all of his books had vast quantities of figures. In keeping with his straitened upbringing, K.O. never wasted a dime. At home he grew much of his food in his spare time, keeping ample supplies of over-wintering vegetables and fruits in his basement at the head of Oyster Pond. When I would meet K.O. for breakfast at 5 a.m. before our early morning writing stints at his house, we often dined on his canned vegetables and fruits. As a graduate student, K.O. continued to ride the rails while commuting between the University of Illinois and the Scripps Institution of Oceanography (SIO) in California. A much later example of K.O.'s care with money played out just prior to the great silver crash of 1980. K.O. had been buying silver, as he watched its price jump from $6 to nearly $50 per troy ounce, thanks to hoarding by the Hunt brothers. K.O., knowing the hoarding would at some point lead to a sharp drop in price, loaded his Volkswagen bug with hundreds of pounds of silver, and drove it alone to the U.S. Treasury in Washington D.C., where he sold his trove to the Treasury just months before the bust hit. This risky solo trip allowed K.O. to maximize his investment as he recognized the boom–and-bust cycle associated with the Hunt machinations.

At Illinois, K.O. earned his undergraduate degree in 1935, and launched into his master's degree, which he completed, partly at the SIO, in 1939 under Shepard, then his Ph.D.

from Illinois in 1941. At the start of the war, there was little interest in the oceans, so K.O. began his working career at the Illinois Geological Survey. Within the year, however, the U.S. Navy Radio and Sound Laboratory in San Diego requested K.O.to return West to resume his collaboration with Shepard at the University of California's Division of War Research and assist with the war effort. In the interim, K.O. had met and married Caroline A. "Kay" Alexander, who became his long-time partner and mother of two daughters.

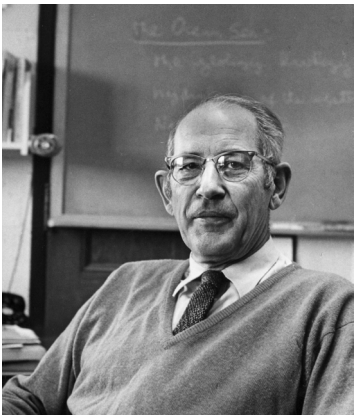
Walking with Giants

The period from 1940 to 1945 was a remarkable time for oceanography, as oceanographers helped the Navy respond to challenges posed by sea wars on opposite sides of the world. During this time Shepard ran a project on seabed acoustics and implications for submarine warfare and when some of the first oceanographic tomes were written. K.O., along with his fellow students and colleagues, immersed himself in these efforts from 1941 to 1945. Some memorable collaborations and long-term friendships were set up with R. S. Dietz, Roger Revelle, Walter Munk, and others.

After the war, K.O. was approached by Tom Clements, the head of the Geology Department at the University of Southern California (USC), who invited him to teach there. At USC he attracted numerous students with whom he would work for decades to follow, including Donn Gorsline and Elazar Uchupi. There K.O. continued his research on the Southern California borderland and initiated new research on the Gulf of California, topics that were to hold his interest for two decades. He interacted with Captain Hancock, who provided USC with the Valero IV, the primary at-sea platform for much of his study. His impactful book, *The Sea off Southern California* (1960), summarized many of his findings on the sediments, structure, waters, organisms, and economics of this continental borderland.

Additional work at USC took K.O. to distant lands. He led a major U.S. Naval scientific expedition in the Persian Gulf, leading to improved understanding of the geological processes on that marginal sea, as well as a continuous bathymetric section across the North Atlantic Ocean. By virtue of a Guggenheim grant, K.O. also was able to do research on the Dead Sea, working with USC student David Neev, who became a life-long collaborator. This work culminated in three Neev/Emery books (1967, 1987, 1995) clarifying the geological history of the Dead Sea from 60,000 years ago to the present, as well as the sense of water circulation, evaporative processes and their impacts, and relative water levels. As was K.O.'s usual method, he and his collaborators relied not

only on at-sea measurements, but also on the Dead Sea scrolls and other archaeological materials!



Dr. Kenneth O. Emery in his office in Woods Hole, MA.

While K. O. was at USC, the United States Geological Survey (USGS) asked him to participate in a study of Bikini Atoll in the Marshall Islands, to assess the possible effects of nuclear bombs to be tested there. Here, K.O. tested and proved a hypothesis proposed by Charles Darwin, who, although best known for his work on animal species and their evolution, also made a number of marine and coastal geological assertions. Among other ideas, Darwin theorized that atolls develop atop submerged and sinking volcanic mountains. Never one to stick to one topic, K.O. also became interested in the navigation methods of the Polynesians. From this interest came a scientific paper identifying the different types of stick and seashell charts of the Polynesian islands, based on wave refraction patterns, that the Polynesians used to navigate from island to island.

In 1962 K.O. was drawn to join the Woods Hole Oceanographic Institution by Paul Fye, its director. Upon arrival at Woods Hole, with Elazar Uchupi, to take up a funded chair there and to lead a comprehensive study of the Atlantic Ocean with USGS funding, K.O. continued his career by entering a phase of synthesis of major marine geological problems. The basin-wide study culminated in his book with Uchupi, *The Geology of the Atlantic Ocean* (1984), covering many aspects of geology, structure, sediments, water, biota, and economic importance. This book followed up on his earlier tome with Uchupi on the *Western North Atlantic Ocean* (1972).

Not one to pass up scientific opportunities, K.O. took advantage of his house's location at the north end of Oyster Pond in Falmouth to satisfy his curiosity about the inner workings of the Pond. His 1972 book, *A Coastal Pond Studied by Oceanographic Methods*, demonstrated the breadth of his scientific questioning, as he addressed physical oceanographic, chemical, geological, and biological aspects of the inner workings of a coastal pond having only a narrow and intermittent connection with the sea. This book demonstrated how interdisciplinary studies of even small water bodies can be conducted fruitfully by a small number of researchers having limited means.

Other of K.O.'s summaries arose from previous interests, while some came from new interests. His work on the eastern Mediterranean included a 1987 book with Neev

and Balker, *Mediterranean Coasts of Israel and Sinai: Holocene Tectonism from Geology, Geophysics, and Archaeology*. Relying on radiocarbon dating and archaeology, the relative sea-level rise in the eastern Mediterranean was proven to be complicated both temporally and spatially. With this thought firmly in mind, K.O. proceeded to investigate relative sea-level change for all the world's coasts, working closely with collaborators D. G. Aubrey and Uchupi. Following a series of some 15 refereed published articles in nearly as many scientific journals, the work was summarized in a book by Emery and Aubrey (1991), *Sea Levels, Land Levels, and Tide Gauges*. This tome identified relative sea-level change caused by glaciation and de-glaciation, tectonic subduction, volcanic activity, faults and folds, delta processes, groundwater pumping, and eustasy—a worldwide sea-level change caused by changes in the amount of water in the oceans or changes in the ocean floor that change the capacity of the oceans. The conclusion was that inferring eustasy from a small number of tide gauges is likely to be erroneous, given the geological contributions to relative sea-level change.

Two later syntheses followed on this work. The first was K.O.'s examination of gunflints from France and England, and a scientific investigation into properties of each of these. Using a novel approach of filming in darkness, he examined the sequence of sparks released by many samples of gunflints from these two provenances. This work was described in a 1988 book by T. M. Hamilton and K.O., *Eighteenth-Century Gunflints from Fort Michilimackinac and Other Colonial Sites*.

I first encountered K.O. as a newly minted assistant scientist at Woods Hole in 1978. I had moved East from the Scripps Institution with high confidence in my skills, having been recruited after completion of my Ph.D. by five top oceanographic institutions in the United States. I chose Woods Hole in large part because of its staff and its role at the leading edge of oceanography. Soon after my arrival, K.O. summoned me to talk with him in his corner office in the Clark Building, which he shared with Uchupi, and which was then the repository of research for the massive compilation on the *Geology of the Atlantic Ocean*. Though a bit nervous at meeting such an eminence in marine geology, I was confident I could impress K.O. with my accomplishments to date, and so walked into his office with my chin up.

Our talk began with K.O. asking about my Ph.D. thesis, its methods and findings. He then queried me as to what other research I had involved myself in. At that time, thinking that a Ph.D. study was adequate by itself, I was pleased to discuss my work and publications on the erosion of the Nile Delta (a subject well known by K.O.), the littoral

Dr. Kenneth O. Emery in his laboratory in Woods Hole, MA.

processes along the adjacent Israeli coast (including the effects of the offshore reefs at Haifa), and my diving observations of nearshore processes. To which K.O. responded, "And what else?" To no avail I mumbled on about some topics that were of some interest to me, but lacking in research results. K.O. expressed his opinion that I should not restrict myself to one or two narrow areas of interest, but attack any scientific problem that I was able to formulate. Chastened, I left his office, intent on meeting his challenge.

Besides this mentoring pep talk, K.O. (along with John Milliman, another colleague) re-taught me how to write using scientific language. Whereas my previous publications had used rather loose writing, K.O. and John forced me to tighten up my writing with better organization, improved grammar, and proper use of words.

These first encounters with K.O. left a lasting impression on my scientific career, perhaps best reflected by the breadth of my published papers since then. I believe K.O. had this effect on his other colleagues and students, as demonstrated by the diverse and passionate productivity of many of them (R. S. Dietz, Uchupi, Neev, H. Niino, and others).

K.O.'s final synthesis related to geology involved the study of the planets, 59 larger planetary satellites in our solar system, and 3445 asteroids. This study produced a classification of major physiographic forms on these bodies as exotic, endogenic, or exogenic. The earth's surface, for instance, has about twice as much exogenic as endogenic activity; by contrast, the Moon's surface in nearly 100 percent exotic from the impact of planetoid or smaller debris. This synthesis culminated in yet another book by Uchupi and K.O. (1993), *The Morphology of the Rocky Members of the Solar System*.

During K.O.'s tenure he was selected to be the first dean of the new Woods Hole Oceanographic Institution/Massachusetts Institute of Technology Joint Graduate Program, another testament to his interest in students. He remained at Woods Hole until his retirement in 1979, upon which he was named Scientist Emeritus.

Additional long-standing interests in world stamps and world coins focused on what stamps and coins told us about marine events, such as ancient harbors, or marine

disasters (for example, the Lisbon earthquake of 1755). It is not yet published, but we can hope that some publishers will pick up these interesting studies that synthesize human perceptions of the ocean as documented by stamps and coins. In total, K.O. had 365 publications of various sorts: articles, books, technical publications. This is a fitting tribute to a hardworking scientist: one publication for each day of the year.

K.O. Emery's career reflected the values that he was brought up with: frugality, directness, hard work, and an inquiring mind. Being a child of the Great Depression, and then maturing with the challenges of World War II, K.O. used marine geology to cement his niche in the history of marine science, while serving his country in his unique and hard-working fashion. K.O.'s long list of students and collaborators were taught similar foundational values, to carry on his legacy for generations to come.

K.O. lost his wife, Kay, to cancer in 1984 (but only after she filled two chest freezers with food to keep K.O. fed for as long as possible after her passing). He was later to marry Phyllis Williams (1985-1991), Joy Joffiens (1993-1995), and Alice Williston (1995-1996). Following the last marriage, K.O. moved to my neighborhood in North Falmouth to be with his younger daughter, Charlet Shave, where he was living when he died, on April 12, 1998.

Honors

Academician, The China Academy, 1968.

Shepard Prize for Marine Geology, 1969.

Outstanding Alumnus Award. University of Texas at Arlington, 1969.

Member, National Academy of Sciences, 1971.

Member, American Academy of Arts and Sciences, 1971.

Prince Albert I Medal, France, 1971.

Compass Distinguished Achievement Award, Marine Technology Society, 1974.

AAAS-Rosensteil Award in Oceanographic Science, 1975.

Henry Bryant Bigelow Chair in Oceanography, W.H.O.I., 1975-1979.

Illini Achievement Award, University of Illinois, 1977.

Member, Royal Swedish Academy of Science, 1977.

Maurice Ewing Award, American Geophysical Union, 1985.

Twenhofel Medal, Society of Economic Paleontologists and Mineralogists, 1989.

Louis G. Murray Visiting Fellowship, DeBeers, South Africa, 1989.

Doctor of Science, University of Southern California, 1990.

Alumni Achievement Award, University of Illinois, Department of Geology, 1996.

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