

# Memorial to Roger Randall Dougan Revelle 1909–1991

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Roger Randall Dougan Revelle, oceanographer, died quietly in his family's presence on July 15, 1991. Roger was great-hearted in every way; finally, though, that heart failed him.

In a high-profile career of nearly six decades, Roger Revelle was a demanding and ever-curious scientist, making fundamental connections between physical observations, an innovative educator whose dream became within his lifetime one of our new great research universities, and an articulate and tireless statesman of science on the national and international scenes. In recent years we've often heard Revelle referred to in television discussions as "the grandfather of the greenhouse effect," a prescient prophet of global warming and the dire changes it arguably would bring. But it is primarily of Roger's earlier and enduring love, geology, and the philosophical geology based on marine field exploration from which a fortunate few created plate tectonics that I speak of here.



Roger Revelle was born on March 7, 1909, in Seattle, Washington, the first of two children of William Roger Revelle and Ella Robena Revelle. His father, a lawyer and schoolteacher, in 1917 took the family to Pasadena, California, where Roger attended the public schools. Entering nearby Pomona College in 1925 with a high school editor's interest in journalism, Roger soon became a devoted student and lifelong warm admirer of the superb teacher-geologist Alfred Woodford. In those years Woodford had as students a stellar and bonded bunch, among them Rollin Eckis, the oil-finder, and the late Manley Natland, Dana Russell, Cliff Johnson, and Mason Hill. In that period, too, Roger met at neighboring Scripps College the La Jolla-born Ellen Virginia Clark, a grandniece of the pioneering Scripps (half) brother and sister who had become benefactors of many cultural activities and organizations in the San Diego area. Ellen and Roger were married in 1931, a year after Roger became a graduate student at UC Berkeley. In time, they raised three daughters and a son.

At Berkeley Roger studied under George Davis Louderback, one of whose many interests was sedimentation. In April 1931, Thomas Wayland Vaughn, then director of tiny Scripps Institution of Oceanography (26-member staff, one small research vessel) in La Jolla, asked Louderback to recommend a graduate student to be based at Scripps to examine sediment cores taken on the seventh and final cruise of the Department of Terrestrial Magnetism's nonmagnetic ship *Carnegie* (ended by boiler explosion in Apia Harbor in 1929). Roger Revelle was Louderback's choice and he went to La Jolla to study and publish several papers on these materials as his doctoral research. His thesis, "Marine Bottom Samples Collected in the Pacific Ocean by the *Carnegie* on its Seventh Cruise," was completed in 1936, and his degree was awarded in May of that year.

In those cozier pre-World War II years Revelle had opportunities—at SIO and during a year's study in Norway—to meet and become lasting friends with a very large proportion of the world's senior and incipient creative marine scientists and young geophysicists, at that time largely based in Scandinavia or western Europe as fisheries scientists, marine chemists and physical

oceanographers. Thus, Roger became a true oceanographer, not a narrowly focused sediment-property analyst, and this outlook colored all of his subsequent marine activities. He also then participated as oceanographer in northeast Pacific cruises aboard the U.S. Coast and Geodetic Survey ship *Pioneer*, and the U.S. Navy's submarine force flagship *Bushnell*; the latter assignment led him to request, and in 1936 receive, a commission in the Naval Reserve. He used his meetings with the uniformed Navy and especially its hydrographic officers to teach and to learn how academic or basic oceanographic science could assist their missions. Meanwhile, in 1937 Roger had returned to the La Jolla home as an instructor and sometime collaborator with Francis Shepard in explorations of the local submarine canyons and continental borderland or the Gulf of California.

In July 1941 Roger Revelle reported for active duty in the navy; from then until 1947 he was in uniform in a number of science-related military assignments: Hydrographic Office, Washington- and western Pacific-based staff assignments, oceanographic research in the Bureau of Ships, and invasion operations planning. As he did in Europe, Roger met a great many American marine scientists and engineers who later would become key players in widely varied research projects and in government agencies. At the close of World War II, Roger, then a commander, was assigned to lead the oceanographic and geophysical components of Operation Crossroads, the first postwar (1946) atomic test at Bikini Atoll, with his team's role specifically to study the diffusion of radioactive wastes and the environmental effects of the explosion. While on Crossroads, Roger was transferred to the Office of Naval Research as head of the Geophysics Branch; there his policy of demonstrating the navy's interest in and support of marine basic research was a key in the subsequent flowering of exploratory research by U.S. academic institutions on navy-provided oceanographic vessel conversions under ONR funding.

At the end of Revelle's naval service he returned to a professorship at Scripps Institution of Oceanography where in 1951 he was appointed director. Scripps Institution's emergence as a premier seagoing scientific entity, observational and theoretical, truly was initiated by Revelle and some enthusiastic young World War II-tested marine chemists-physicists-biologists-geologists who wanted to go adventuring in a time of discovery, developing a new multifaceted seafloor exploration that was given great impetus by the technical advances and ongoing evolution in equipment that had been born in undersea warfare. Similar far-flung programs soon were undertaken by Woods Hole Oceanographic Institution under Columbus Iselin and Lamont (today Lamont-Doherty) Geological Observatory led by Maurice Ewing.

In the summer of 1950 Roger led SIO's first true deep-sea geological-geophysical expedition, MIDPAC, with SIO's *Horizon* and the U.S. Navy Electronics Laboratory's EPCE(R) 857. Its two-ship seismic refraction program under Russell Raitt demonstrated the relative uniformity of crustal velocity of characteristic layers under the deep ocean floor and the surprisingly thin overlying sediments (surprising, that is, if such ocean basins were indeed ancient permanent sinks) that do thicken toward the borders and overlie apparently volcanic rocks. MIDPAC's scientists explored and delineated the huge submerged Mid-Pacific Mountains seamount complex and dredged shallow-water Upper Cretaceous rudistids from the flat-topped guyots, permitting Edwin Hamilton to prove that these peaks were not, as Harry Hess had hypothesized, Precambrian volcanoes on a somewhat older seafloor. Three of these discoveries became cornerstone clues in the mid-1960s elegant theory of plate tectonics.

Roger, too, with Arthur Maxwell and Sir Edward Bullard, discovered and measured variation in heat flow from Earth's interior emerging through the seafloor sediments; they suggested that heat must be transported upward by slow convective churning of the mantle. Two years later a similar two-ship geological-geophysical expedition, CAPRICORN, again led by Revelle, explored much of the southwest Pacific, including the Fiji basin, Tonga Trench, central Polynesia and part of the East Pacific Rise. From CAPRICORN dredging of the Tonga Trench (finding apparent exposure of hard rock on the deep nearshore flank) and trenchward tilting of the flat-

tened summit of huge guyot on the offshore flank, Robert Fisher and Roger Revelle in 1955 suggested the ongoing crustal movement in compression, with material entering the trench and being lost, an early version of "subduction." Additional 1953–1960 trench geophysical studies by SIO scientists fully confirmed this interpretation off Central America, northern Chile, Indonesia, and the Tonga Trench.

While Roger Revelle did on occasion go to sea on research cruises after 1952–1953, and notably on the MOHOLE Test off Guadalupe Island and WIGWAM atomic test in 1955, he came to liken himself to a modern Prince Henry, sending his younger scientists and graduate students forth across the world as expedition leaders who ran their entire sea programs on their own. Meanwhile, he found the financial and technical support their explorations required by promoting shore-side support in La Jolla, San Diego, and Washington, D.C. Here, Roger, as a scientific leader, had a rare and wonderful gift: he trusted. As SIO's director he chose carefully and well, and then he trusted. Roger was generous in all things; with him, credit wasn't a zero-sum game.

Throughout his life after he became director of SIO, Roger was a vital member, most often chairman, of dozens of high-level university, national, and international commissions and advisory committees; for some years those were very far removed from geological oceanography. He was president of the 54-nation First International Oceanographic Congress held at the United Nations headquarters in New York in 1959. One outcome of this conclave was the multination, 20-ship, coordinated-discipline International Indian Ocean Expedition from 1959–1964 which built on the cooperation engendered in the International Geophysical Year, 1957–1958. Intensive geological work on that area, prior to 1960 virtually unknown, continues cooperatively in several geophysical-geochemical programs. Revelle was a founding member and first president of SCOR, the Special (now Scientific) Committee on Ocean Research of the International Council of Scientific Unions, and he helped UNESCO establish its Office of Oceanography. He was a founding advisor to UNESCO's Intergovernmental Oceanographic Commission. In 1955 Roger became a "founder" of the American Miscellaneous Society (all AMSOC members become "founders" on entry!) and in 1973 was awarded its backhanded, if not inverse, Albatross Award. Through AMSOC Roger participated in early MOHOLE planning and Guadalupe seafloor test drilling on *CUSS I*, on which overside methods of ship positioning vital to successful drilling by DSDP's *Glomar Challenger* were first tried.

During a leave of absence from SIO's directorship in 1961, Revelle became the first science advisor to the Secretary of the Interior. Possibly his most significant contribution in this position was as chairman of a White House–Interior Panel on Water Logging and Salinity in West Pakistan created by President John F. Kennedy at the request of Pakistan's President Mohammed Ayub Khan. Its on-site mission was to combat serious drops in agricultural yields from the fertile soils in basins of the Punjab and Indus rivers; Pakistan's rural population no longer could be fed. The recommendations of Revelle's study group were accepted and followed by the Pakistani government, and the region's agricultural yield increased about 7% yearly for the next decade. In addition to acquiring an enduring liking for the Indian subcontinent overall, Roger was decorated by Pakistan's president with its Order of Sitara-i-Imtiaz.

Nearer to home, however, Roger Revelle's worth was recognized early by his peers, whether geologists or other; he was laden with honors and degrees. In 1957 Roger was elected to the National Academy of Sciences, and in 1973 to the presidency of the American Association for the Advancement of Science. As a marine scientist he received the Agassiz Medal (from the NAS), the Albatross Medal of the Swedish Royal Academy of Arts and Sciences, and in 1968 the American Geophysical Union's William Bowie Medal. The last seems especially apt because it is awarded for "unselfish cooperation in research." Late in 1990 Roger received the National Medal of Science from President Bush. Less visible but more enduring, perhaps, in the western Indian Ocean north of Madagascar there is a mile-high elevation in the seafloor, nearly as large in area as

New England. Commemorating all that Roger gave to that part of the world, it now is known as Revelle Rise.

When someone does write a real biography of Roger Revelle, geologist-oceanographer-educator-statesman-friend, I might suggest the title, "Not Soon Again."

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