

ROGER REVELLE: A Profile

Judith and Neil Morgan

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Note from Peter Brueggeman, SIO Library Director: An MS Word file on 3.5 inch diskette was given to the SIO Library by Kittie Kerr Kuhns of the SIO Technical Publications Office, before that office was disestablished at the end of 2002. Diskette was labeled "Revelle/final. Morgans 8-1-96." The text was prefaced by "FINAL, book.rog, 23,524 words, ROGER REVELLE: A Profile. By Judith and Neil Morgan." There are editorial differences between this text and the final book, which was dated August 30, 1996 in its foreword. The foreword and chapter headings from the final book have been added to this August 1, 1996 authors' text.

FOREWORD

Roger Revelle was an internationally respected statesman of science. He transformed Scripps Institution of Oceanography from a shoreline field station into a world renowned oceanographic institution, founded the University of California at San Diego, and served as an inspired teacher and distinguished researcher. He was a proponent of U.S. Navy/academic collaboration and creator of the Office of Naval Research; an expert in population and resources; and the first scientist to recognize issues of carbon dioxide emissions, the greenhouse effect, and global warming. His influence continues to be felt worldwide.

Those of us who knew Roger also remember him as a person. He was a man of large stature and an easy manner, with a penetrating mind and a deep persuasive voice. It is his character and presence that Scripps wanted to recall when his friends Neil and Judith Morgan were asked to write this profile. They wrote it as Scripps's new research vessel, *Roger Revelle*, left the shipyard in Mississippi and steamed toward San Diego to become the newest ship in the institution's fleet.

Edward A. Frieman
Scripps Institution of Oceanography
August 30, 1996

AUTHORS' NOTE

Whenever appropriate, we have used Roger's own words as the primary source in our interpretation of the events of his life. The unattributed quotations are his, as set down in authors' interviews, periodicals and scientific journals, letters, books, and in a collection of oral histories -- notably those of Sarah L. Sharp for The Bancroft Library, University of California, Berkeley; Robert A. Calvert, Texas A&M University; and Dr. Kathryn Ringrose, University of California, San Diego. We are indebted to them and their institutions and to the Scripps Institution of Oceanography archives and the Special Collections of the UCSD library. We thank Ellen Revelle Eckis for her generous store of recollections and her patience; Deborah Day, the Scripps archivist, who is especially well versed in Roger's life and science; and past and present members of the faculty and administration of Scripps Institution of Oceanography, UCSD and other educational and governmental institutions and to family and friends who have shared memories and files. Three books of particular value were Nancy Scott Anderson's history of UCSD, An Improbable Venture (La Jolla: UCSD Press, 1993); Scripps Institution of Oceanography: First Fifty Years by Helen Raitt and Beatrice Moulton (Los Angeles: Ward Ritchie Press, 1967); and Scripps Institution of Oceanography: Probing the Oceans, 1936-1976 by Elizabeth Noble Shor (San Diego: Tofua Press, 1978).

Roger

He was a big man, a lanky six-feet-four in his prime, with a lopsided smile that could both charm and challenge. He thought that his eyes were green, but others considered them blue, changing hues as often as the seas. Before his hair turned silver it had been brown and wavy, completing the patrician look of a carelessly handsome man of limitless assurance. Yet his feet were so large -- he wore size 15 shoes -- that sometimes, as he strode familiar hallways and decks and grounds, his mind always racing ahead, he tripped himself and lurched to get back in stride. Dancing, his wife Ellen soon learned, would be a contact sport. The feet flawed the otherwise suave image and gave him occasion to make fun of himself, which he did rather endearingly. But few others risked making fun of Roger Randall Dougan Revelle.

Around the world, from Berkeley to Zurich to Moscow, scientists looked up from their conference desks and smiled when this towering, unpredictable American entered the room. The breadth of his ideas made him formidable, and sometimes their audacity. He rebelled against the restraints of academic dogma, leaping at challenges from which many shied. Complexity never frightened him. He relished human contacts and the clashing of good minds. As a man of intense focus and enviable memory, who thought and spoke clearly, he gunned down poseurs by asking simple questions such as “Why?” or, even deadlier, “Why not?” When he was eighty years old he heard a young artist tell the San Diego Arts Commission that the city could “become the cosmic city of the world.” While others nodded, Roger, who had seemed to be dozing, lifted his head: “What in the world do you mean by THAT?” Rivals saw him as dangerous because of his dogged determination, and he slowly mastered the guile to sway most of those who doubted him. Exceptions were notable, however, including Indira Gandhi and the occasional University of California Regent.

As a twentieth-century oceanographer, Roger considered himself part of a golden age of discovery, an era he likened to that initiated by Prince Henry the Navigator. He spoke of the geographic links between Portugal, anchoring the southwest corner of Europe, and San Diego’s position in the United States. He was a scientist but “not a very good one,” he conceded, remaining an explorer at heart, an old-fashioned naturalist who picked up bits of fossil and bone and scraps of ideas wherever he went and paused to ponder where they had come from and what they meant. His genius was in his visions of linking science and war, science and peace, science and humanity, science and the global environment. He became an evangelist for science. But his forte was always innovation, not administration. “I’m pretty good at starting things,” he said in his low, rumbling voice, “but not very good at finishing them.” Clocks and calendars meant little to him, and at sea he reveled in his release from routine.

To colleagues, he could appear thoughtful or thoughtless, depending on whether you were the young graduate student, surfboard at hand, who hailed him on the beach and, for most of an hour, sought advice about his future -- or the assembled faculty committee kept waiting in his office during that hour. Yet they waited, for Roger was often an inspired leader. Many of his letters began with profuse apologies for tardiness and proceeded into leisurely travelogues and declarations of enduring friendship.

In lectures and correspondence as in conversation, his language was bold and robust, demonstrating his eternal capacity for wonder. He favored hyperbolic phrases

like “spectacular results,” “remarkable discovery,” “giant worms and clams.” His scientific papers sometimes lapsed toward adventure stories that might be told around a campfire. When he sought funding to take Scripps Institution of Oceanography on its first major deep-sea expeditions in the 1950s, his tantalizing proposal to the University of California Regents cited the enormous gaps in man’s knowledge of the sea -- mysteries, he assured them, that could only be solved by on-site scientific measurement. He got the money, and Scripps began probing the Pacific.

Roger was a man of enormous appetites who sought to taste all manner of excitements. At the age of seventy he tried to sum up his strengths and weaknesses: “I get interested in a lot of different things, never perhaps pushing any one thing far enough.” Yet he clung to the dream of building a great research university adjacent to the Scripps campus in La Jolla, battling powerful and unforgiving foes to make it happen.

He was, above all else, a man who cared passionately about people, whether his own children and grandchildren or the impoverished, malnourished farmers he sought out as he studied their plights in India or Zambia or Nepal. He thrived on conversation, inquisition and collaboration. Though some colleagues called him tyrannical, others thought of him as an overgrown Boy Scout. One scientist explained him to a new faculty member this way: “You can always predict what Roger will do by asking yourself what Sir Galahad would do in the same situation.”

Early Years

When Roger, at the age of sixteen, enrolled at Pomona College in 1925, he was certain that he would become a journalist. He liked writing and had enjoyed the camaraderie on the student newspaper at Pasadena High School. He edited the college humor magazine (“...odd, because I have practically no sense of humor”) and, in his junior year, became co-editor of the campus newspaper, throwing himself with a rapidly emerging single-mindedness into its conversion from weekly publication to daily. Eventually he succeeded, even though it meant staying up until 3 a.m., night after night, “to get the goddamned paper out.” He began dozing off, square jaw dropping to his chest, during his 7:30 a.m. physics class and the calculus class that followed, so offending his professors that both warned they might flunk him.

But by then he had made an ally of Alfred O. (Woody) Woodford, the one-man geology department at Pomona, who became his mentor and champion. After one memorable field trip to a flat-topped erosional remnant rising above an alluvial fan two miles north of the campus, Roger was hooked on the mysteries and excitement of science. “On the first or second session...Woody took [the class] up to Indian Hill ...and when we had gathered, he asked: ‘How did this hill get here?...Look around and tell me what you see and think.’”

There was no simple answer, but the game was on. This hilltop conversion never faded from Roger's memory, echoing three decades later when he began recruiting faculty for the new University of California campus at San Diego. During walks to the highest knoll of Torrey Pines Mesa above La Jolla, he would ask academic visitors to “look around and see” with him the great campus he envisioned.

Roger revered Woodford for teaching him three vital lessons: a knowledge of the vocabulary of geology, “so that I was able to read the literature easily”; a recognition that [in spite of that literature,] little was actually known about the earth and its history, “but that it was possible through research to find out a good deal”; and that geological research was “wonderfully exciting and very good fun.”

Fun became an operative word for Roger. The clear evidence that this tall man was having fun at his work drew many people toward him throughout his life, while repelling others. It soon became predictable. The strait-laced or pretentious would be forever wary of Roger Revelle, sensing the threat of his derision. “Roger’s people,” as many came to call them, were those who worked hard but, like him, developed a sense of the ridiculous and were quick to enjoy the ironies of life. Such men and women shared with him an enduring and ebullient fraternalism.

After graduating in 1929 Roger remained at Pomona for a year to work with Woodford and be near his fiance, Ellen Virginia Clark, a junior majoring in child psychology at neighboring Scripps College. She was a great-niece and namesake of the philanthropist Ellen Browning Scripps. “How would you like to be a professor’s wife?” he asked, a proposal Ellen found presumptuous but irresistible. In the fall of 1930, Woodford arranged a teaching assistantship for Roger in the geology department at the University of California at Berkeley, launching the young scientist's “lifelong love affair” with that campus. “Whenever I go to Berkeley, a chill runs up and down my spine from the sheer joy of being there.” At the redwood faculty club, from his earliest days, he watched in awe as professors played cribbage and kriegspiel, and he came to love the old

brick geology building next to the campanile. His admiration grew for the geology department chairman, George D. Louderback, whom he began to emulate. Roger liked his Socratic seminar style and his role in a faculty revolt that established the "almost omnipotent role" of the Academic Senate. He carefully observed Louderback's office, "with [its] many tables, all of which were covered by a foot of papers, with a stratification going down to the early Tertiary, but he never had any trouble finding a paper when he wanted it." Roger's office would later be similarly described.

His skewed sense of timing and basic dislike of mornings made the going rough when Roger was assigned to teach an 8:30 a.m. class in the Life Sciences Building. He often found himself so tardy that he ran all the way from his bachelor quarters at the International House -- it was downhill, he recalled -- and arrived "sweating and panting" to scribble a quiz on the blackboard and then slip out to the men's room to shave.

In the spring, T. Wayland Vaughan, a natty geologist who directed the Scripps Institution of Oceanography, came to Berkeley seeking a graduate student to spend a year at his La Jolla outpost, studying and classifying muds collected by the yacht *Carnegie* from the deep sea floors of the Atlantic and Pacific. Vaughan was not unaware of Roger's impending connection with the Scripps family. Spurred more by romance than professional foresight, Roger applied. Since Ellen had been born in La Jolla and the family summered there, the seaside community seemed a likely haven for their first year of marriage.

Besides, he concluded, mud had been part of his heritage. His grandfather, "Captain" George Reville, had been a successful oyster fisherman on Maryland's eastern shore, owning a clipper-bowed, rake-masted boat. He sent four children through college on the income from the undersea resources of Chesapeake Bay. Roger's father, William Roger Reville, valedictorian of his class at Western Maryland College, had moved west to Seattle and studied law at the University of Washington. With two brothers, he had set up the firm of Reville, Reville and Reville. Roger's mother, Ella Robena Dougan, was a willful but frail woman of Irish descent who also attended the University of Washington. Roger was born in Seattle on March 7, 1909, and schooled at home until he was eight; by then the family had moved to Southern California, hoping the climate change would relieve his mother's asthma. Although tutored by his parents, he learned more, he said, from reading all twenty volumes of the Book of Knowledge. It gave him a start on his lifetime pursuit of wide-ranging curiosities.

The wedding was on a sweltering June evening in 1931, reportedly the hottest day recorded in neighboring Pasadena. Roger Reville, 22 years old, gawky but charming, and a starry-eyed Ellen Clark, almost 21, weighing 98 pounds and standing a foot shorter than her groom, were married at her mother's home in San Marino. To guests the affair appeared flawless. But the bride already sensed what life with her impetuous husband would be like. He seemed particularly nervous, "miserable" from a fiery sunburn that was a painful reminder of his stag party at the beach. The wedding trip to British Columbia was postponed because he had less than a week before the summer session began at Berkeley, where he planned to cram on physics to make up for his "dismal performance" at Pomona and prepare for his work at Scripps.

Finally in late August there was time for a drive up the West Coast in what Roger called Great Gatsby style. He drove a Chrysler convertible, purchased with a wedding check from her great-aunt Ellen. In Victoria, they called on Roger's Cockney-born Aunt Lizzie, who hailed the bride from the top of her stairs: "Is it 'elen with an 'H' or Helen with an 'E'?"

In La Jolla the newlyweds moved into her mother's seaside home on Vista del Mar, awaiting a promised vacancy on the Scripps campus hillside. It was a white board-and-batten cottage in the picturesque colony that made the little Scripps community an enclave apart from the village itself. Roger recalled the early days at Cottage 24: "John Wells, later a famous specialist on fossil corals, lived downstairs, and a well-behaved but noisy family of skunks lived under the house." Their "million-dollar" sunset view, through a scrim of Torrey pines and Monterey cypress, was of the Pacific, the oceanographers' pier, and the curving cliffs and surf line of La Jolla. Roger's \$100 monthly salary was augmented by the \$25 Ellen received in income on a bequest from her great-aunt, and in those Depression years they managed better than many. They paid \$10 a month in rent, and \$6 more to share a maid with another graduate couple.

Roger was one of only five research assistants at Scripps in 1931, and his work unfolded in casual ways. One day his colleague Dick Fleming came by Roger's lab and said: "You're the new boy here. Tomorrow we go to sea. I'll pick you up in front of your house at 2:30 a.m." Throughout his life Roger recalled the events of the next day as a watershed, with the most trivial occurrences bathed in wonder. In "pitch darkness" they drove to the San Diego Yacht Club on Point Loma and boarded Scripps' only ship -- "a 64-foot, 11-inch former purse seiner" renamed *Scripps*. They sailed out of San Diego Harbor, "past the bell and the whistling buoys to an area over 1,000 meters deep, some fifteen miles west of Point Loma." There Roger and his colleagues lowered into the sea a set of Nansen bottles with reversing thermometers. It was a weekly ritual in Scripps' year-round study of ocean conditions off San Diego.

Fleming seemed to be in charge. At mid-day he told Roger, "You're the new boy, so you get to cook lunch." In the tiny galley below, Roger put together a "wonderful meal" of steak and boiled potatoes, with a salad of lettuce and tomatoes. The three others came down, bolted their food in silence and announced that to avoid seasickness they would go topside and continue taking seawater samples while Roger washed the dishes.

It was almost 5 o'clock when they turned back toward port, arriving well after dark. "It was one of the finest days I had ever spent," Roger recalled. "I believe I decided then and there...that I would spend the rest of my life as an oceanographer. Being at the same time a sailor and a scientist seemed too good to be true." He knew it was too late to discover new lands on Earth, but the oceans, covering more of the globe than land, were as exciting a prospect for discovery as anything sighted by Columbus or Sir Francis Drake. He had found a way to pursue geology without scaling mountains or striding along cliff edges, which he dreaded because of lifelong acrophobia: "...the only heights to climb were the rope ladders attached to the masts of ships, and on these you could hang on with your hands as well as your feet."

Back on campus there were Dr. Vaughan's muds to attend to -- those from the *Carnegie* and some calcareous mud from the Bahamas. The assignment launched Roger's lifelong interests in calcium carbonate and carbon dioxide, leading to seminal studies of the buffer mechanism of sea water and concerns about the prospect of global

warming. At Scripps, Roger learned to avoid boredom and professional disaster by shifting to others the tasks and responsibilities he found difficult. Another assistant, Eldon Thorp, was better than Roger at taking microphotographs of thin sections of the director's beloved corals. "After a while Dr. Vaughan relied on 'Thorpy' to do everything, which was very good as far as I was concerned. It's what my friend Giff (Gifford C.) Ewing calls 'dynamic incompetence.'" But Roger wasn't a bona fide shirker. He proceeded with identifying the director's bottom samples (aragonite needles) from the Bahamas, which led to his first published paper. Working with three other scientists, including the chemist Erik Moberg, he went on to study the buffer mechanism. Moberg was meticulous and Roger found him intent on tedious revisions. As a result four European oceanographers were published ahead of them with similar findings.

The sea was always tugging. Roger studied diligently and passed an exam for a small-craft operator's license (for boats up to 65 feet in length) so that he could relieve the captain when the *Scripps* began venturing beyond Catalina Island on two- and three-week cruises. "It was a useful, maturing experience, because no matter the size of the boat, there's a lot of responsibility...coming in to anchor, for example, and not running into something...[it] helped me to be a boss later in life."

At day's end Roger was slow to leave the dock or lab, often returning to Cottage 24 late for his bride's dinner but charged with fervor for his new world. When the Revelles were first married he came home for lunch; after several meals went cold, Ellen realized that Roger's "lunch" might be anytime from noon to three, depending on work and distractions. She had two favorite recipes: baking-powder biscuits and cheese souffle. But the timing of the souffle was too precise for Roger and after a few collapsed, she never cooked another. "I should have known," Ellen said, "that tardiness was his way of life." He never overcame it. Rudeness was not his intent; he would simply become so engrossed in a subject, an experiment or a stranger's question that he lost all sense of time. It was related to lifelong procrastination. He had meant to write Ellen letters during their courtship but put them off. He meant to correspond more often with his parents and to remember his sister Eleanor's birthday, but these duties fell to Ellen. From his youth, letters that he did succeed in writing reflect his awareness of such failings. "Allow me to apologize for my tardiness," he wrote Professor Woodford in 1929. "Thanks for sending my overcoat and the picture of the *Scripps* which I carelessly left behind in Cambridge," he wrote an English colleague in 1936. Library books piled up long past their due dates. He was even pursued into postwar years by the Office of Naval Research and Atomic Energy Commission for failing to return a confidential file about nuclear research at Los Alamos.

His mother had been painfully aware of such traits, and his marriage did not slow her efforts to improve him. In 1933 she wrote urging him to write his father, his sister and grandmother, and to stop smoking -- "deliberately trying to destroy (your) organs...particularly the brain...by the vicious habit of smoking cigarettes." That same year she rebuked him for tying a bumper placard on his car supporting repeal of the 18th (Prohibition) Amendment "while working for a public university."

Above all, he meant to complete the study of Dr. Vaughan's muds, but every cruise aboard the *Scripps* turned up intriguing puzzles, discoveries and friendships. It took almost five years for Roger to finish "looking at the goddamn mud" -- after considerable prodding from Vaughan, who was about to retire. His dissertation (*Marine*

Bottom Samples Collected in the Pacific Ocean by the CARNEGIE on its Seventh Cruise) led in May of 1936 to a Ph.D. degree awarded by President Robert Gordon Sproul at the UC Stadium in Berkeley.

The sea was taking an ever greater hold on Roger. So little was known about the deep ocean that he had felt like a pioneer as he boarded a U.S. Navy submarine tender, the *Bushnell*, on a summer training cruise to the Gulf of Alaska, the Aleutians and Hawaii. The Navy's entire active submarine fleet was participating: two tenders and six subs. His assignment for Scripps was to take a series of hydrographic stations -- measuring, at varying depths, the water temperatures, salinity, phosphate, nitrate and oxygen. The Navy provided a bunk -- it involved some torture for a six-foot-four researcher -- lab space, and a pharmacist's mate as assistant. It was his first glimpse of the Navy at work, and he quickly sensed that the new science of oceanography might be of lasting interest to the Navy. Naturally Roger got well acquainted with the admiral. "(He) and I shared a common weakness. We both tended to get seasick when the *Bushnell* was pitching into a head sea. The place of minimum motion was right at the fantail, and we spent a good many hours there together." The ship's captain, Abel T. Bidwell, would become an important ally.

The scientific results of that cruise are uncertain. But it led to a bond between Roger and the Navy that helped to shape Scripps Institution of Oceanography, the directions of research in oceanography worldwide, and even the outcome of World War II. The emergence of that relationship affords a view of how Roger thought and schemed and worked, rarely seeming to look far ahead but shaping his life as opportunity presented and always alert to creating opportunity. He was gregarious and made friends easily, swiftly learning how powerful friends could open doors "to get science done."

The *Bushnell* captain sensed opportunity too. Bidwell urged Roger to join the Naval Reserve, which he did in 1936 as a lieutenant (junior grade), despite high blood pressure, flat feet, and his height. Roger wrote his new boss at Scripps, the renowned Norwegian oceanographer Harald Sverdrup, to put on the record why he had applied. "I felt that in any future oceanographic work on board a naval vessel it would be best to be able to give and take orders, rather than being in the anomalous position of a paying guest. This rather slight liaison with the Navy may also be of some future value to Scripps Institution; and in any case is good fun."

In the summer of 1936, two weeks after Sverdrup and his wife Gudrun had arrived in La Jolla, the blithe young oceanographer, Ellen and their two daughters -- Anne, almost four, and Mary, six months, -- made their first trip to Europe, sailing from New York to Southampton. Ellen's grandfather, James Scripps, had willed her a share of income from *The Detroit Evening News*, giving the Revelles a degree of financial independence rare in Depression years. Roger had accepted an invitation to spend a year of post-doctoral study, at his own expense, at the Geophysical Institute in Bergen. Roger's intensive work-and-travel pattern was emerging. He arranged the journey to include professionally pivotal stops in Washington and Edinburgh. At the Navy's Hydrographic Office he discussed the potential rewards of Scripps research. The letter the 25-year-old Revelle wrote Sverdrup was prescient:

"I mentioned the possible application to long range weather forecasting of a knowledge of change in oceanic circulation; the various ways in which physical and chemical oceanography may aid fisheries and allied industries; and the value of a

knowledge of oceanic circulation to geologists in their interpretation and understanding of problems of marine sedimentation, particularly in their search for petroleum....They were looking for arguments to use...in order to secure ships for this type of work.”

In Edinburgh at a meeting of the International Union of Geodesy and Geophysics and its International Association of Physical Oceanography, Roger presented several Scripps papers on which he had worked with Fleming and Moberg. They included a significant finding on the distribution of oxygen and phosphate in the North Pacific. At a reception Roger was approached by a fellow delegate who shared his interest in the subject. He was Columbus Iselin, Roger’s senior by five years, who later became director of the Woods Hole Oceanographic Institution.

The science of oceanography was so young in 1936 that the thirty oceanographers attending that Edinburgh conference included most of the world’s top men. Roger met them all. Their research and expeditions were centered in Norway, Denmark, Great Britain and Germany; in America oceanography was still relatively diffused and unrecognized. But Bjorn Helland-Hansen, with whom Roger would be studying in Norway, had visited Scripps a year earlier and assisted Vaughan in his search for a successor. "Amongst the young oceanographers," Helland-Hansen wrote, "I have especially noted Mr. Roger Revelle whom I regard as a coming man, but he is probably too young for such a position now."

While Roger lingered with colleagues and new friends in Edinburgh, Ellen searched Bergen in vain for a house to rent. She was in some distress by the time Roger arrived. "Oh, I forgot to tell you," he said. "Harald has arranged for us to rent a place that belongs to his aunt." The aunt, they soon learned, was also a relative of Edvard Grieg. They were charmed to find the home in the suburb of Paradis, the next trolley stop after Hjel (pronounced *hell*) and Hop (pronounced *hope*). Neither knew any Norwegian, having been assured by Gudrun Sverdrup that "everyone in Bergen speaks English". That proved true among scientists, but not in the town itself except during summer, when student clerks were hired to deal with tourists on their way to the fjords and the Midnight Sun.

Gudrun, a native of Oslo, had warned that it rains "32 days a month in Bergen." But the Californians plotted country picnics during intermittent blue skies, relying on the "masterful intuition" of a new friend, meteorologist Jacob "Jack" Bjerknæs. Later a professor at UCLA, Bjerknæs had discovered how low pressure systems develop in the atmosphere, and in World War I had forecast weather for western Norway. "Jack could look at the weather map and say, 'It's going to stop raining at 12:15 p.m. and we can go for a picnic. But we have to be back by 3:15, because the rain is going to start again.'" Roger insisted that Bjerknæs’s predictions were never off by more than ten minutes.

With the first snows, Roger went to pick up the ski boots he'd ordered and found the cobbler reluctant to let them go. Ellen recalled "they were on display in his shop window -- the largest boots he'd ever made." After wanderings through the old Hanseatic port Roger would dictate long reportorial narratives to Ellen to type for Fleming and Sverdrup at Scripps and for Captain Bidwell: "I walked down to the docks to mail a letter to America by way of England, on the famous North Sea ship *Venus*, going to Newcastle. The ship is supposed to leave at 11:30 in the morning, but...you can

be practically sure of catching [it] at 20 minutes to 12. It is still a sporting proposition at a quarter of 12." His letters have occasional Ellen inserts such as "Stenographer sends love" and "Steno balked at rest."

He soared when dictating, and the harbor scene fueled his wanderlust:

I prowled around, peering at labels of barrels and boxes, trying to look nonchalant when eyed by suspicious customs guards, gaping at little coastwise steamships and big ocean-going freighters, and snub-nosed fishing boats with stained, unpainted wooden sides and wooden nails. There were many things being loaded and unloaded...barrels of salted herring from Tromso and Hammerfest, fresh cod packed with ice, bound for Hamburg and Antwerp; sacks of dried fish for Brazil, burlap wrapped bales of cotton from America, sheet steel from New York...casks of olive oil from Marseilles, onions from Holland, lemons and shelled nuts and canned tomatoes from Italy; grapes from Spain, packed with ground cork in kegs bound with split birch saplings...goats milk cheese from Sognefjord, West Indian bananas, South African oranges...and many other things with undecipherable names from all the earth's far corners.

The Revelles sailed from Bergen in the fall of 1937 bearing geologic samples for Scripps. In New York they were the last to leave the ship because a customs inspector was suspicious of Roger's halting declaration that his steamer trunk was "full of rocks." Years later, Roger reflected: "As a young post-doc, I would have done better scientifically to stay at Scripps and work with Harald [Sverdrup]...I didn't learn much about oceanography [in Bergen], but I did learn a good deal about people."

War Years

While Roger was in Bergen, Scripps' sole research vessel, the little *Scripps*, on which he had first gone to sea, exploded and burned at its moorings in San Diego. But Sverdrup, adamant that oceanography be studied on the oceans, persuaded Robert P. Scripps, the son of newspaper tycoon E. W. Scripps and nephew of Ellen Browning Scripps, to fund a replacement. Sverdrup chose a 104-foot, Gloucester-type, two-masted, topsail schooner named *Serena* that had been owned by film actor Lewis Stone. He ordered its 100-foot masts lowered by 28 feet and installed a more powerful diesel engine. After being icebound for seven years in the Arctic on Roald Amundsen's expedition ship *Maud*, Sverdrup had "little love left for the romantic side of sailing." Some staterooms were converted to laboratory space. With the deep sea in mind, Sverdrup demanded two large winches, each capable of carrying almost four miles of cable. Renamed the *E. W. Scripps*, the vessel had a cruising radius of 2,100 miles and could remain at sea for a month or more without refueling. Roger saw it as "the second great leap forward [after the hiring of Sverdrup] in the evolution of Scripps toward a genuine world oceanographic institution."

When the Revelles returned from Norway, the Institution family was still a small, ragtag bunch living in close campus quarters: five full-time graduate students and ten or eleven maverick scientists pursuing wildly independent studies. Francis Shepard, a marine geologist from the University of Illinois, a "keen and tireless observer," had joined the staff as a visiting professor. Slight of stature, he enlisted Roger to assist in measurements of waves and rip currents by wading into the buffeting surf to serve as a "wave staff." Shepard was fascinated by the deep submarine canyons that cut into the continental shelf off La Jolla, and spent increasing time rowing out from the pier to take lead-line soundings. Of primary import, Shepard brought with him a \$10,000 grant from the Geological Society of America, most of which went toward the cost of operating the *E. W. Scripps* for a year.

After short cruises along the California coast, the vessel was ready for Scripps' first major exploratory voyage: 800 miles southeast around Baja California and into Mexico's largely uncharted Gulf of California. Sverdrup would lead the expedition. Roger helped load on unwieldy gear, much of it built from "junk lead and scrap pipe" by Scripps men, including a device to bring up nine-foot-long cores of mud. In February of 1939, he and eight other scientists and a crew of six made the voyage under sail, "a fuel conservation measure," and then launched the first oceanographic survey of what was romantically called the Sea of Cortez. Their findings debunked old myths: the Gulf floor was not a gently sloping depression, but a rugged landscape of steep ridges, deep basins and troughs; what fishermen reported as oil slicks were masses of single-celled organisms floating on the surface; and the Seri Indians of Tiburon Island, while primitive, were no longer cannibals, if they ever had been.

Most interesting to Roger was the Gulf itself. "While the shore was a desert, the water teemed with life." The explorer Hernan Cortez had called it the Vermillion Sea, and Roger thought it looked like tomato soup. His natural and scientific curiosities overran. "It had an enormous plankton bloom and if you went out in a small boat at night and dipped your oars, the whole sea would light up for hundreds of yards around the ship...from luminescent organisms." Although scientists did not yet suspect it, the Gulf

proved to be a boundary between tectonic plates, “a place very much like the Rift Valley in Africa or the Red Sea, where the earth is pulling apart.” Its puzzles so intrigued Roger that he applied for a grant to support a return cruise -- to be led by Shepard and himself -- for further geologic findings in the autumn of 1940.

Roger’s people were coming onstage. In 1939 Walter Munk, an Austrian undergraduate who was eight years Roger’s junior and “so willing, cheerful and enthusiastic,” had arrived from Caltech on a summer fellowship. Munk went to Sverdrup, asking to remain as his student. “He was quiet for a full twenty seconds,” Munk recalls, “and finally said, ‘I can’t think of any job in oceanography that will open in the next twenty years.’”

“I’ll take it,” Munk said.

At the Scripps library Munk noticed two tall piles of library books that remained on a desk untouched for two weeks. He was told someone named Roger Revelle had checked them out and not been seen since. When Roger finally revisited his books, he sat down to talk. “This lasted several hours,” Munk recalled. Soon they were teamed to sit for four hours at a time in Shepard’s rowboat, anchored over the canyon, raising and lowering instruments. The work was slow and tedious, and conversation flourished. Munk stayed at Scripps throughout his career, becoming Roger’s staunch ally and friend. His status was unique from the start; Roger introduced him at La Jolla parties by saying, “This is our student body.” Munk said later, “The second most important thing in my life after knowing my wife is having known Roger. I loved him.”

With Sverdrup as his mentor, Roger was recommended for promotion from instructor to assistant professor. “He has an unusually clear mind and ability of applying knowledge from other fields to...specific problems,” Sverdrup wrote President Sproul. “Owing to his training and his enthusiasm for oceanographic research, I feel confident that his services will be of increasing value to the institution.”

Before the findings of the second Gulf of California expedition could be published, wartime pressures interrupted. Roger was called to active duty in the Navy in July, 1941. The *E.W. Scripps* was placed at the disposal of the Navy Radio and Sound Laboratory just above the vessel’s home pier on Point Loma.

In February of 1941, as German submarines threatened Allied shipping across the Atlantic, Lieutenant (junior grade) Roger Revelle had been called for Naval Reserve training as a sonar officer aboard the *Rathburne*, a World War I destroyer used as a schoolship. Five months before Pearl Harbor he reported for active duty at the Navy lab on Point Loma. Throughout World War II, from San Diego to Washington and into the Pacific, he saluted with the Boy Scout salute: “It’s the only one I ever learned.” Still, his company was good and his understanding of the sea and the Navy made him welcome in gold-braided ranks. He was a scientist, but he could manage to sound Navy. They had bent the rules to sign him up, and by war’s end he would rank as commander.

Roger’s work patterns changed less during wartime than those of most Americans. At the lab he was teamed with physicist Norman Jefferis “Jeff” Holter to make oceanographic studies of West Coast harbors and inlets as far north as the Straits of Juan de Fuca. He helped to start the Navy’s first radar operators’ school and worked on

underwater sound at the University of California Division of War Research (UCDWR) on Point Loma. Roger quickly had his own war stories:

The lab was full of hot shots from the physics department at Berkeley, led by Ernest Lawrence, who had the idea that these damned oceanographers were stupid and that the thing to do, instead of fooling around with underwater sound, was just to get a big light underwater and [you could] see a submarine... He started an optical group that built this huge searchlight with millions of candlepower. And they had a black sock, twenty feet across and a couple of hundred feet long, to be a sort of imitation submarine. Well, you could see this sock (for) about 20 feet...the scattering of light underwater created so much background that you didn't get any contrast...It didn't work very well...Then all these hotshots disappeared all of a sudden. We heard that they went to a place called Shangri-La. This was Los Alamos, as we found out after the war.

It was a wrenching time for foreign-born scientists. Roger and Commander Rawson Bennett, with whom he had worked before the war on underwater sound propagation, made frequent pleas on behalf of Scripps colleagues. As a native of Austria, Walter Munk endured a long security investigation and his access was limited. Sverdrup, the Norwegian, lost his clearance to work at the UCDWR lab, but remained at Scripps, feeling that he could do more for the war effort through science than through the resistance movement in his homeland. Among many contributions, Sverdrup and Munk developed the vital surf forecasting methods used in Allied amphibious landings, starting with North Africa. The prediction for General Eisenhower on D-Day would be that the surf conditions at Normandy would be "poor but possible."

Roger's primary duty in San Diego was teaching Navy radar operators, and he grew restless. "You teach the same thing over and over again." He found his captain to be a "little tyrant...a really terrible person (who) delighted in humiliating his officers in front of the enlisted men and then giving them impossible assignments." He appealed to Bennett, by then head of the design branch in the electronics division of the Bureau of Ships: "I just gotta get out of here. This is impossible."

Late in 1942 orders came transferring him to the Hydrographic Office in Washington. Now his boss was "a nice old admiral, but he didn't have any idea about World War II or what an oceanographer could do in the war. He put me to work looking at a submarine bank that had been found somewhere off the coast of Panama [which was] very interesting because it didn't exist. Some ships had picked it up on their fathometers...others couldn't find it." It turned out to be the deep scattering layer, "but the people out at UCDWR were just finding out about the layer at the time." The Hydrographic Office was "a hopeless place...entirely a charting outfit, making maps in that same old-fashioned way they'd been doing for a hundred years."

Roger told Bennett he wanted to work for him in underwater sound, and Bennett realized that Roger would not be useful to the Navy under a heavy hand. Two months later he made Roger officer in charge of a Bureau of Ships subsection studying sonar design. It

was from this base that Roger did most of his oceanographic work throughout the war. He became project officer for UCDWR, for the Woods Hole Oceanographic Institution and for the Navy's underwater sound lab at New London, Conn.

Roger had sensed that with oceanography he was in an age of discovery, and its role in the war confirmed it. He was near the core of the liaison that developed in wartime between academic research and the military. The Manhattan Project became its most significant progeny, but the Navy's chief interests were oceanographic. The National Defense Research Committee, set up in 1940 under Vannevar Bush, was considered primarily a weapons research team. Scientists at Scripps, Caltech, MIT and others teamed with for-profit research firms like Bell and Gulf. The science of oceanography was advanced and diversified through Navy ties, bringing a remarkable torrent of geophysical and oceanographic data that helped to allay scientists' apprehensions of their task-assigned roles. At the same time came a steady flow of military hardware breakthroughs in fields including underwater acoustics, search and rescue. Research yielded smoke screens that shielded warships from kamikaze raids in the Pacific, and the technique for computing shallow-water depths from aerial photographs, vital in Allied troop landings. Oceanographers developed high-frequency underwater sound systems to track submarines and detect mines. They identified the crackling sonar interference caused by flotillas of snapping shrimp and used that sound as a sonar cover to shield U.S. submarines. They studied the drift of life rafts under various winds and currents, and Sverdrup himself designed what Roger called "waterproof handkerchiefs", emergency maps issued to aviators locating currents and islands over which they flew.

As the military plotted invasions of the Japanese mainland in the summer of 1945, Roger was in the Pacific instructing intelligence officers in wave measurement. At Guam, Admiral Raymond Spruance arranged for him to brief Admiral Chester Nimitz, then commander-in-chief of the Pacific Fleet, on the breakthrough in measuring water depth on landing beaches. "I didn't get much response [from Nimitz] at all...He was the most intimidating guy I ever met...frosty blue eyes....[I] mumbled and stumbled...but he must have known about the bomb because he wasn't very much interested." (After the war, as a University of California Regent, Nimitz became a staunch friend to Scripps and Roger.) Roger moved on to Manila to the staff of Admiral Redmond Kelly Turner, commander of the amphibious force expected to go into Japan. "In the instant that I climbed the ladder of *Eldorado*, [the admiral's] flagship, the news came over the loud speaker that they had dropped an atomic bomb on Hiroshima."

The liaison of scientists and the Navy moved faster and farther than Roger had dared to hope. In 1944 Navy research staff had proposed that the National Academy of Sciences establish a security research board. In December Roger flew from Washington to California for an extraordinary discussion with President Sproul. Now head of the oceanographic office of the Bureau of Ships, Roger foresaw a continued rush of classified research contracts after the war, and believed that Scripps should have its share. How would a program be structured? Sproul and his staff, well aware that there would be faculty wariness, agreed to set up a discrete administrative unit in San Diego to handle government contracts; it became the Marine Physical Laboratory. For director, Roger proposed the University of Chicago geophysicist Carl Eckart, who had spent the war years at UCDWR and would now hold a Scripps faculty appointment.

Maneuvering like diplomats, Roger and the brilliant astronomer Lyman Spitzer, his principal colleague at the National Defense Research Committee, had drafted a letter from the Bureau of Ships to Sproul that was sent early in 1946, formalizing an estimated fee of about \$175,000 a year in federal funds for Scripps research on underwater sound. Academic apprehensions yielded to reality: a year after war's end, the total University of California budget would allot only about \$100,000 to research. In 1946 the powerful Office of Research and Inventions (later the Office of Naval Research) was established and the Navy assigned Roger as head of its geophysics branch. This was the Navy's first long-term commitment to university-based research, and it became the primary source of funding for Scripps as classified projects of wartime were transferred to San Diego. The Radio and Sound Lab where Roger had first reported for duty was renamed the Naval Electronics Laboratory, and the Marine Physical Laboratory became the peacetime successor to UCDWR.

Roger had played an astonishing number of roles in plotting Scripps' future, and his own postwar civilian career seemed clear. Admiral G.S. Bryan of the Navy's Bureau of Ships told the American Geophysical Union that the emergence of global warfare had made oceanography essential to national security. He cited work done at Scripps and paid "particular tribute" to Roger.

John Isaacs, a wartime research engineer at Berkeley and an imposing man himself, would always remember his first sight of Lt. Roger Revelle: a tall, slender figure in Navy dress blues standing in beach sand at California's Morro Rock. Isaacs was working with the Navy in surf tests of amphibious landing craft; Roger was coming along for a ride.

"The driver took sadistic joy in plunging [us] into a towering breaker, [even] scaring himself," Isaacs recalled. But when they emerged from the foam, Roger was still standing, "on deck and upright, salt torrents pouring out of the sleeves of his uniform, carrying on his discussion of our problems with that oblivious intensity that always characterized his curiosity."

The two had met again in the fall of 1945, when the newly-created Department of Defense prepared to set off the fourth and fifth atomic explosions, testing the effects of over-water and underwater detonations on naval ships. Operation Crossroads would involve hundreds of Navy vessels and a team of 1,000 scientists and technicians in what was called "the most complicated laboratory experiment ever undertaken." It would take place at some remote Pacific island requiring a minimum displacement of inhabitants and with minimal radiation risks. But which island? Roger, by then a commander, was assigned to the Joint Task Force as chief oceanographer. They needed enough land to set up measuring gear and laboratories. They preferred calm seas for seaplane traffic, and a site relatively free of hurricanes, which meant, Roger pointed out, not venturing far into the western Pacific.

Staff meetings were led by Admiral William Henry Purnell Blandy, in whom Roger found another mentor with intellectual curiosity and a strong leadership style. "Blandy did all the voting, but he was so good at it that he would find a consensus every time, or nearly all the time. It was...remarkable to see how he operated." Eventually they chose Bikini, a two-square-mile atoll strung around an oval lagoon in the Marshall

Islands, just north of the equator in the central Pacific. "It really wasn't an awfully good place, but there aren't any awfully good places."

From watching Admiral Blandy debate with meteorologists "on their own grounds," Roger learned the power of using "sheer logic and...penetrating rationality" to catch specialists in "inconsistencies and uncertainties." He set to work honing this skill. Isaacs said, "Roger organized the scientific side [of Bikini] singlehandedly." His assignment was to make oceanographic surveys of the lagoon before and after the test. The goals were to contrast the waves created by both bombs, to trace the diffusion of radioactivity inside and outside the atoll, and to learn the effects of the explosions on the organisms of the atoll and the coral reef itself.

The bomb crew from Los Alamos did their work in a secluded lab on nearby Eniwetok. Roger's team included Isaacs, Munk, Ewing, Holter, Martin Johnson, Bill Von Arx, Ken Emery and "hundreds of enlisted men who lived only to receive their discharge papers." Sometimes a Navy crew would set out to transport oceanographers and their equipment to the far end of the atoll "only to turn the boat around halfway and return to the ship, saying their discharges had arrived...They usually had."

Isaacs was on the coco-palm beach erecting three 100-foot towers on which to mount automatic cameras for time-sequence photographs. Heavily encased, wave-pressure recording devices called "turtles" were placed on the lagoon bottom. Roger was delighted by Holter's "wonderfully simple" idea for measuring wave height from the blasts: he set poles in shallow water at the edge of the lagoon, gathered friends for beers, and then attached the empty beer cans to the poles at one-foot intervals. If the cans were filled with water after detonation, it meant the waves had broken over them.

On July 1, 1946, all ships had been pulled out of Bikini lagoon except for the target fleet: seventy war-weary vessels including the aircraft carrier *Saratoga* and battleship *Arkansas*. A shipload of observers, including congressmen and the press, had arrived. Roger boarded Admiral Blandy's flagship, *Mount McKinley*, and put on "protective cardboard dark glasses" for the nuclear countdown. "I was standing next to Norris Bradbury, who was my classmate at Pomona College and [now was] director of the Los Alamos Laboratory...When the air bomb was dropped, Norris jumped up and down...very pleased that it had worked."

But it was the underwater detonation on July 25 that awed Roger and startled the scientists: "There was this huge pillar of water...a great, hollow column [2,000 feet in diameter] shooting up more than a mile above the lagoon." Then it fell back in a storm of waves, steam and debris, becoming "a doughnut-shaped base surge almost a thousand feet high and moving very fast [toward us]...we thought it was a huge wave...that our estimates had been completely haywire." But it slowed, stopped, and finally became so light that it lifted from the surface. "All it was was spray...and it spread out, covering a lot of ships with radioactive water." Witnessing this phenomenon, the Navy adopted tactical plans for the nuclear age, based on dispersing its fleet so an enemy might not destroy more than one ship at a time.

From their ecological surveys of Bikini before the first bomb was dropped, and evidence from a return trip in 1947, Munk, Ewing and Roger wrote a paper ("Diffusion in Bikini Lagoon," *Transactions*, American Geophysical Union, Feb. 1949), that was one of the first dealing with empirical measurements of oceanic diffusion. "Roger wrote the book on radiation damage," Munk said, citing his major contributions to two National

Academy reports on the biological effects of atomic radiation and its impact on oceanography and fisheries.

For Roger, some pure science was the most satisfying result of Bikini. After studying the movement of “artificial earthquake waves” caused by the explosion, and drilling through the atoll’s coral cap and 4,000 feet of reef limestone, seismologists confirmed a bitterly-contested, nineteenth-century hypothesis that atolls are formed from sunken volcanic islands above which coral has slowly and continuously grown, upward and outward.

“In other words,” Roger said gleefully, “Charles Darwin was right!”

Expeditions

When Roger had left the campus to go to war, Scripps had one small vessel, three permanent buildings and a staff of 26. He returned in 1948 to an institution with four ships, a staff of 250 and a budget of nearly \$1 million. Office and lab space were at a premium. The mood was upbeat, and campus dress was more casual, with lots of Hawaiian shirts. The Revelles and their four children had settled into the oceanfront home that had belonged to Ellen’s mother.

After Sverdrup submitted his resignation as director to return to Norway, Carl Eckart, head of the Marine Physical Laboratory, became interim director. He was a compromise candidate; Sverdrup believed Roger was the man to lead Scripps out of its laboratory confines and into ocean exploration. But four senior faculty members strongly protested that he was unfit for the top role. He had been away from academia for seven years, and he was not yet forty.

Eckart and Roger had worked well together in wartime and held each other in high regard. Soon after Roger returned, Eckart named him associate director, and after “two agonizing years” as an administrator, the gentle Eckart resigned to return to full-time research. On February 24, 1950, President Sproul proposed Roger's name to the Regents as acting director, to serve until a search committee found a successor. There seemed no opposition.

At that same Regents meeting, however, came a vote so divisive that the core of the University was threatened. It ordered the dismissal, without a hearing, of faculty members who refused to sign a “loyalty oath” disavowing membership in the Communist Party. The McCarthy hearings had fueled nationwide witch hunts. The deadline was April 30; Roger was enraged. He refused to sign the “negative” oath and urged his faculty to join him. Old friends like Rollin Eckis and Karl Rodi, who had known Roger from college days, warned him he would jeopardize his future by leading the opposition. But Roger was in “a crusading mood” by then. “I have some principles, and the principle of academic tenure [is one of them]. I was willing to go pretty far for that.” As employees of the State of California, all faculty members had signed a loyalty oath to the constitution, he argued, and without tenure “the university becomes just a business.” The furor grew into a power struggle between Regents and faculty over governance of academic affairs; even the faculty was divided.

Roger met with the media and argued the case before civic groups. One night he took Munk along as he spoke to a citizens group in San Diego’s Balboa Park. It was not

a good night for Roger. When he finished, someone asked if he were a Communist. He was not, he said. "Then why don't you sign it?" he was asked, and the room erupted in applause. But he rallied Scripps professors and their families to write letters and circulate petitions. Both southern and northern sections of the University Academic Senate condemned the Regents' action, and Governor Earl Warren and President Sproul sided with the faculty.

Roger's most important convert, he felt, was the tough Marine Corps general, Holland M. "Howling Mad" Smith of La Jolla, who held a law degree. "He thought that the Regents were just way off base. He told me about the time that 'a couple of the good ladies of La Jolla' were talking to him at a cocktail party and said, 'We don't understand why those professors aren't willing to say they aren't Communists.' General Smith had replied, 'Madam, if somebody asked you to take an oath that you were not a prostitute, what would you do?'"

An uneasy compromise was reached in April. Regents ruled that faculty members who refused to sign a "statement" -- a less strident term -- might appear before a committee of the Academic Senate to explain why. If their reasons were deemed unworthy by their peers, they might be dismissed -- not because they wouldn't sign the oath but because "they were suspected of being or maybe actually were Communists."

Of this action Roger recalled: "[Regent] Mario Giannini, the son of the founder of the Bank of America [said]: 'The flags will fly in the Kremlin tonight. I hereby resign from the Board of Regents.'" Then Governor Warren, as presiding officer, won Roger's heart and vote. "[He said] 'Mario, this is a democracy and it's your duty to stay here and persuade us that we're wrong, not to resign.'"

Roger's desk as the acting director was immediately buried in paper as unrelenting curiosity and wanderlust led him to more active roles. Woods Hole had claimed and explored the North Atlantic and the Mediterranean; the Pacific belonged to Scripps. So Roger believed, and he was quick to stake his claim. Munk recalls the seagoing 1950s as "among the most glorious days of my life." In the fall of 1949, at the age of 40, Roger plotted and then helped organize Scripps' first deep-sea expedition. It would be a three-month, 25,000-mile voyage to the mid-Pacific, far from any ship lanes, a part of the earth almost totally unknown to science.

Roger's proposal to the University of California included riddles like, "What is the ocean floor really like?" Most geology textbooks described "a flat and featureless plain", but wherever new echo-sounding methods had been used, Roger contended, "the bottom has proved to have relief comparable to that of the Rocky Mountains or the Sierra Nevada." In seeking \$60,000 for the expedition, he mentioned potential bonuses that would be a "service to mankind": learning more about air masses and weather prediction, finding new sources of food for a protein-hungry world. His lyrical logic prevailed.

The resulting University of California-Navy Electronics Laboratory Mid-Pacific Expedition, called MIDPAC, would require two ships -- one to lie still in the water while scientists listened through cable-connected hydrophones; the other, from 50 miles away, to run toward it, setting off TNT charges to produce sound signals in the water. From this operation, the oceanographers traced the structure and thickness of the crustal layers below the Pacific, leading to the first continuous profile of the sea floor. Before the war,

federal funding for marine science had been miserly; now the Navy offered surplus naval vessels that could travel half-a-world farther than Scripps' converted fishing boats and yachts. For the seismologist Russell Raitt there were stores of surplus explosives. There were new instruments, developed in wartime, that would extend their scientific reach.

Roger gathered 32 scientists and 85 technicians and crew members, charting a looping course from San Diego to the Marshall Islands. In 1950, this expedition was national news -- a "voyage of discovery" that brought reporters to campus and docks, learning that Roger, the college journalist, was eminently quotable. The Scripps men ransacked their labs and homes, scavenging wire cables and Nansen bottles, coring tubes and fathometers. On July 27 two ships sailed from San Diego: a 143-foot Navy tug rechristened *Horizon* and a 220-foot research vessel on loan from the Navy, known only as *EPCE(R)-857*. Scientists were stationed on both ships; on the *Horizon* with Roger were Raitt, Arthur Maxwell, Ken Emery, Bill Menard, Bob Dietz, and Jeff Frautschy. Roger called the captain, Jim Faughn, "one of the unsung heroes of the new age of exploration". Faughn's mettle was quickly tested.

"After about four days at sea, the clutch on one of 857's engines broke down," and officers "strongly hinted" they should return to San Diego, a move that would doom or delay MIDPAC. While the *Horizon* could cruise 10,000 miles without refueling, 857 carried fuel for only three or four days. When the 857 cozied up for refueling, Captain Faughn carefully doled out less than was necessary to return to port, and the expedition limped on toward Navy shipyards at Pearl Harbor, where Roger convinced authorities that MIDPAC was a priority for the Office of Naval Research.

With the 857 in dry dock for two weeks, the scientists boarded *Horizon* to explore the ocean floor west of Hawaii. Through long, sultry days, dredges clanked and grated and winches squealed. Frautschy began taking cores; Raitt measured sediment thickness. Below deck, men worked in a stifling lab, a jumble of sinks, work benches and sample bottles. Crew and scientists stood watches, working round-the-clock shifts, seven days a week, lifting cables, taking readings, checking meters, uncoiling lines, drinking coffee. Roger stayed up beyond his watch, "gradually going around the clock, sleeping at later and later times, until finally I started all over again, because I was so interested in what was happening, what we were finding." He proved to be a likeable and inclusive leader, a good listener who played fair and held his temper. When the vessels pitched and rolled, Roger spoke reverently of the recently developed drug Dramamine as "a major scientific contribution to oceanography."

On September 9, 1950, following radio messages in Morse code from the *Horizon*, Scripps made headlines around the world with the discovery of a "great elongated mountain range, west and south of the Hawaiian chain, perhaps a thousand miles long and more than sixty miles wide", with peaks almost 14,000 feet tall. During these weeks, much that scientists had assumed was overturned. The sea floor was young, not old. The bottom was rough, not smooth. Sediments were thin, not thick. The heat flow was high, not low. The newly named Mid-Pacific Mountains, Roger said, "were formed during the last eye flick of geological time, compared to the rocks on the continents...There is nothing very old anywhere on the deep sea floor."

Meteorologists sent up radio-bearing balloons and found the weather at 100,000 feet as variable as at sea level. An improved underwater camera provided photographs of ripple marks on the sea floor, 20,000 feet down, from previously unsuspected deep

currents. The first hints of sea-floor spreading appeared, but their significance went unrecognized. "Scripps missed the boat on that," Munk said. "Others put it together to come up with the revolutionary discovery of plate tectonics."

In equatorial waters biologists collected hatchetfishes with rows of night-sparkling photophores on their sides. In core samples from 9,000 feet down, Richard Morita discovered bacteria in a state of suspended animation which, when brought to surface atmospheric pressures, began to grow rapidly. Eager to bring them back alive, he kept the unknown bacteria in a shipboard refrigerator and was outraged to learn Roger had removed some specimens to make room for beer. To Morita's protests, Roger replied: "Young man, you must realize that there are times when beer is more important than biology." It certainly was at sunset, Roger's favorite hour, when he strolled to the fantail as the tropical sky split into his favorite streaks of blood-orange, marigold and purple. Sailing south along the international date line, they "oscillated back and forth between Sunday and Monday most of the day. Very confusing." When the vessels steamed on toward Bikini, Roger and a dozen others -- some more reluctantly than others -- flew home from Kwajalein; they had been away for ten weeks.

For his unswaying stand on the loyalty oath, Roger had won respect from faculty leaders at UCLA and Berkeley, and these alliances grew invaluable. Still, on returning from MIDPAC, he seemed no closer to becoming director of Scripps. The four opposing senior faculty members -- Denis Fox, Carl Hubbs, Francis Shepard and Claude ZoBell -- sent an impassioned letter to President Sproul. While they held Roger "in high regard as friend and colleague", they could not endorse his candidacy as director. "He seems to have almost no conception of time, either in meeting appointments or in closing meetings," they said. "[His] occupations, including extramural interests, take him away from the Institution a large proportion of the time and keep him so rushed when in his office that appointments often prove difficult, particularly during ordinary hours." They cited his "impetuous enthusiasm and crusading spirit" which "led him repeatedly to [abandon] a major project in mid-stream when a more appealing enterprise [comes to] his imaginative attention." His "generous heart" had led to at least one "disastrous" appointment. Roger was unaware of the letter at the time, but sighed when he read it years later. "I was pretty headstrong. I wanted to have my own way about many things. I hadn't really learned how to manipulate a committee, which I did learn later."

Taking political counsel from his friend Burt Walford, chief biologist for the U.S. Fish and Wildlife Service, Roger organized a national conference in March of 1951 on the "Future Position of the Scripps Institution in the University, State and Nation." Such visibility, Walford assured him, would "cause the opposition to evaporate" and garner enough prestige to assure Roger's appointment. For Roger the filip of the conference was a Charter Day celebration at La Jolla Beach and Tennis Club, attended by renowned scientists including President Detlev Bronk of the National Academy of Sciences and Columbus Iselin, Director of Woods Hole, President Sproul and leaders from other campuses. The petroleum industry and the Bureau of Ships, good Scripps clients, were represented. Roger's far-flung network made an impressive supporting cast. The event culminated with the dedication of the Thomas Wayland Vaughan Aquarium-Museum. "The only other true oceanographic museum in the world is at Monaco," Roger had

written President Sproul when he sought and won University financial support for the conference.

Four months later Roger was appointed director. But he was careful to avoid the trappings of rank. His unmarked office was on the second floor of the aquarium building and, for a time, the only sign on the staircase read: MEN'S ROOM.

Director Roger

The early years of that tenure were joyous ones for Roger, who knew himself as a "starter, not a finisher." He loved to stroll around the campus that had been his home for more than 20 years, dropping into offices and laboratories "to talk to people about what they were doing, to encourage them to do their best." He launched a weekly "brown-bag" luncheon seminar, believing it vital for growth and morale "to have everybody know what the others were doing." Thriving on the spark of ideas, he "always did some teaching," sharing his excitement as he scribbled and leaned against the blackboard, his chalk-smearred jacket becoming a campus landmark. "Professors are a sorry lot," he would mutter. In the spirit of his Pomona mentor he took graduate students on beach walks and out to sea, quizzing them about the world around them. "Look at the new moon!" he exclaimed one evening. "Why can you see it?" When no one answered, Roger gave an exposition on earthshine that geologist Wolfgang Berger cherished.

Committed to "try to do some science, some actual research," he published papers with Munk on the rotation of the earth and joined Arthur Maxwell and Sir Edward "Teddy" Bullard in research on heat-flow in the ocean floor. He worked with Isaacs, Edward D. Goldberg and Theodore R. Folsom on a paper on "Nuclear Science and Oceanography", read at the first International Conference on the Peaceful Uses of Atomic Energy. But his administrative style remained slipshod: once he neglected to sign the campus payroll and hastened to take a personal bank loan to cover salaries.

Little more than a year after becoming director, Roger was eager again to go to sea, this time to lead the ambitious Capricorn expedition. Its scientific goals were similar to those of MIDPAC, but in more southerly waters. Most of Scripps' geophysicists and geologists were along for the five-month voyage; marine geologist Gustaf Arrhenius, a hardy veteran of Swedish Deep Sea Expedition, was on board as a visitor and later joined the Scripps faculty to study deep-sea cores. The *Spencer F. Baird* put out from San Diego on September 26, 1952, to rendezvous with *Horizon* at Bikini for the first explosion of a thermonuclear bomb on November 1. Munk, Isaacs and Roger were concerned that the powerful new bomb would trigger a massive landslide and launch a tsunami; at Navy expense, they had set up an elaborate emergency evacuation system for neighbor islands. On the day of the blast, Munk and Willard "Bill" Bascom sat in skiffs just outside the Bikini reef, intently watching their pressure gauges, ready to flash the signal that would trigger the evacuation if the readings soared. They didn't; but the mushroom cloud moved toward them, raining radioactive water, and they scrambled to board the *Horizon*, which was anchored directly under the fallout and remained a "hot" ship for years.

The scientists worked the seas south to Fiji, Tonga, Samoa, and back across the South Pacific through the Cook Islands, the Tuamotus, the Society Islands and the Marquesas. Their discoveries seemed less spectacular than those of MIDPAC, but their understanding of the sea and the unique Pacific trenches grew with each sampling, measurement and dive; Capricorn was the first expedition to carry scuba divers. Roger called the geologist Bob Fisher "trenchant" because of his absorption with the huge trenches, the deepest places on earth: At first Fisher shouted "Ole!" each time their ship crossed over the deepest point, but "soon he became blasé" about being 30,000 to 35,000 feet above solid ground. "On expeditions, Roger was first among equals," Fisher said, "and thank God, because we did discover a lot of things done over his skepticism."

Munk always found pleasure in going to sea with Roger, who, he said, "didn't really know when to say 'No', and who [as chief scientist] was willing to take chances...It wasn't always a very conservative undertaking, but it was lots of fun."

Senior geophysicist Russ Raitt's wife, Helen, flew to Fiji to meet the ship for the Christmas holidays, and eagerly accepted an invitation to stay on board for the remainder of the voyage -- the first woman to sail on a major Scripps expedition. Roger, who had known Helen since college, commended her warm heart and civilizing influence, and wrote the introduction to her book about the journey, Exploring the Deep Pacific.

This was the South Seas before tourism, the islands of Gauguin and Robert Louis Stevenson. Capricorn members enjoyed rich contacts as natives often welcomed them with flowers, feasts and dancing. At Christmas, 1952, the men -- and Helen Raitt -- were in Tonga as guests at a royal luau given by Prince Tungi, the "400-pound son" of the reigning monarch, Queen Salote, a woman almost Roger's height. The visitors sat on braided palm mats, spread on a white sand hill above the surf. "A very pleasant occasion," Roger wrote, "with beautiful Tongan girls, one Tonga girl per man, kneeling by you and feeding you from banana leaves used as plates." Lorries loaded with singers serenaded the island into the early morning hours.

Never a diver and not a strong swimmer, Roger liked to splash around near the beach. Helen Raitt watched him wading through the reefs, "shoes and all" (he had not found size 15 sandals), "moving those huge long legs in and out of the water, encumbered by gear he was carrying for the divers." He loved the "gin-clear" waters north of Fiji where he could view the tops of coral reefs 60 feet below.

The technical innovation of Capricorn was a new winch on the *Baird* -- "the biggest, strongest winch of any oceanographic ship from the United States." It held nearly eight miles of tapered steel cable. From a huge storage spool below deck, it coiled through winding machines aft of the main deck laboratory and over a pulley suspended from an A-frame steel tower rising 32 feet above the deck. The winch had arrived in San Diego too late for a test; Roger was wary, fearing it would run wild "like a fishing reel" of deadly proportions. On a blustery, overcast New Year's Day over the Tonga Trench, a thousand-mile-long trough seven miles deep, it happened: with six miles of cable played out in a heaving sea, the winch slipped out of gear. The cable jammed and knotted. The threat of capsizing was unspoken but the danger of losing the cable and ending the expedition seemed imminent. Roger "looked white under his tan." For hours, the crew cut and spliced wire, praying that their "come-along" clamps would hold the ten tons of cable already hanging in the sea. Roger called it "about the worst twenty-four hours I ever spent in my life." At last the cable began to wind and "the noisy clankings and rattlings were heard again...the sound was good to the ears."

He later wrote: "I have often wondered why it is so pleasant to be on a small, oily, and uncomfortable ship, far from the nearest land. This is true even in the midst of a vicious storm, let alone on one of those wonderful days in the tropics when the sea and the air are smiling and calm. I am convinced that it is because on shipboard both the past and the future disappear -- only the present is left. You can't do anything about your mistakes of yesterday; [and] the future depends so much on the unpredictable whimsies of ships and the sea that planning for tomorrow is futile."

Capricorn was Roger's final expedition.

Back in La Jolla Roger sought more faculty, ships and buildings, and more fully integrated the Marine Physical Laboratory on Point Loma with Scripps. He wooed celebrities -- his correspondence with Jacques-Yves Cousteau is a triumph of humility -- meeting them at a conference in Marseilles or Bangkok and then luring them to La Jolla to see his campus and be seen on it. Traveling frequently to Washington, he networked and lobbied for ocean sciences through the National Academy of Sciences, to which he was elected in 1957, the Office of Naval Research and a dozen government committees. Roger was hoping fervently that science might provide a gateway to easing tensions of the Cold War, and his efforts and those of colleagues around the world raised a surge of public interest in oceanography. He was a leading planner of the eighteen-month International Geophysical Year in 1957-8, then the largest worldwide effort of science. Roger was the American among five founders of SCOR, the Special (later Scientific) Committee on Oceanic Research of the International Council of Scientific Unions, and became its first president. It was a group that exercised moral suasion among some scientists and led to the first International Oceanographic Congress, over which Roger presided at the United Nations in 1959. Then came the four-year International Indian Ocean Expedition, involving 40 ships from a dozen nations including the Soviet Union, at work "in a neutral ocean, the least-known on earth." To Roger's great pride, Scripps' *Argo* sailed there in 1960, "a new ship venturing into a new ocean" on the longest trip yet undertaken by Scripps. To seagoing scientists like the expedition leader Bob Fisher, the intermediate depth plateaus of the Indian Ocean became as familiar as the Mid-Atlantic Ridge and the chasmic trenches of the Pacific. Discoveries included the thirteen-mile sediment fan on the floor of the Bay of Bengal, the thickest in the world, built by centuries of runoff from the Himalayas down the Ganges.

Roger chose his people and then trusted them. "Once out of sight of Point Loma, you were in charge," Fisher said. "You were never Roger's puppet."

When he had learned at Pomona College that the ocean's carbon dioxide content might be 60 times greater than that of air, he started down a trail that led to his study of critical carbon dioxide changes in the atmosphere. This became a major research project during the International Geophysical Year as he and Hans Suess theorized that Earth might be growing warmer. Charles David Keeling had joined Scripps in 1956 to direct the carbon dioxide study, bringing scientific precision to Roger's instincts, and after some disputes over sites and methods (Roger wanted to take measurements in many places over a long period of time), Roger deferred to Keeling in his choice of Hawaii and the South Pole for continuous measurements of CO₂ levels beginning in 1958. "Roger was a very strong-willed person," Keeling said. "He wouldn't sign my travel orders to go out and set up my instruments at the Mauna Loa Observatory because he wanted me to do it his way first." By the second year of readings at Mauna Loa, they could already see the rise in CO₂. With Keeling's patient, relentless documentation, Scripps work became central to a concern that gained world recognition. By 1975 he and Roger would show that atmospheric carbon dioxide had increased by five percent in twenty years, one-third of it probably due to clearing of forests for lumbering and cultivation, and much more to the burning of fossil fuels and biospheric CO₂ depletion. Roger's work on the resulting

greenhouse effect was cited as one of his achievements in 1973 when he was named president-elect of the American Association for the Advancement of Science. As it became a political and social issue across the Western world, he served on a series of related panels and committees, including one for the National Research Council, which in 1983 issued its pivotal study, Changing Climate. With this work Scripps had begun to widen its curricula and goals from the seas to man's total environment. Roger argued that as scientists grew to understand the interaction of sea, land and atmosphere, it was folly to isolate their research.

He had become a major figure at home as well as abroad, and many basked in his hearty affection. On his fiftieth birthday, the warmth was reciprocated with a street party that spread among oceanographers' homes along Ellentown Road. Roger was carried aloft on a sedan chair, accompanied by clouds of confetti as Keeling, "the chemist-musician," played the calliope. Far into the evening, Roger was presented a beribboned crate from which sprang the tall, blond stripper "Texas Bobbi" Roberts, one of the city's favorite daughters. After Roger had crawled back inside with her and the two had been whisked down the block, she emerged with a dazzling smile to say: "I never knew there was that much to oceanography!"

At the Revelle home, family dinners swung from seminars to lectures to songfests, with Roger enthusiastic but rarely in key. Conversations reflected his catholic interests, his compassion for the world at large, his love of poetry and his disdain for pretension. Roger's mood set the tone, and it was not always pleasant. Gary Hufbauer, married to his daughter Carolyn, recalled: "Woe to the dinner guest who offered an ill-considered opinion. I quickly realized never to rely on a half-remembered fact." Scientific curiosity abounded. Carolyn talked of her father calculating "how much alcohol someone of my body weight could safely imbibe at my high school graduation." William, the youngest, born in 1944, felt like part of an extended family. "Of my father's five children, one was a university. It was always strange to have a university for a sibling."

The Revelle home was the site of the one-time-only staging of "Endless Holiday," a satiric musical production by John A. Knauss, a Scripps graduate student who led expeditions during the IGY and went on to become chief of the National Oceanic and Atmospheric Administration (NOAA). (Two Scripps expeditions had been called Northern Holiday and Southern Holiday, although the latter was renamed Shellback so Regents would not consider the endeavor frivolous). The show involved a mythical expedition of *Horizon* for which Roger had neglected to get Regents' permission. The vessel was adrift in the Pacific, mermaids were boarding and the Regents refused to allow its return. In a parody from *H.M.S. Pinafore*, Roger mugged and waved his arms silently, by popular request, while Bill Van Dorn, a specialist in waves and tsunamis, stood behind him singing.

Soon the Scripps campus grew too large for such intimate frolics. Roger felt regret when marine biologists, chemists, geologists, and physicists broke off into "more or less semi-independent divisions": the Institute of Geophysics and Planetary Physics, the Marine Life Research Group, Hans Suess's Carbon 14 laboratory atop Mount Soledad, the Visibility Laboratory, the Applied Oceanography Group, the Climate

Research Group and others. Roger's essay on the evolution of man's study of the oceans, in *Scientific American* in 1969, would be his valedictory to the seas. By then seven Scripps research vessels were at work, one on a round-the-world cruise. Roger had turned on the Navy connection, and it was raining ships. Even wide-eyed graduate students led oceangoing research projects.

Yet he shrugged as he looked back on his twelve years as Scripps director: "I always tried to do too much, and I spent a lot of time in Washington, which I thought was good for the institution, but [some] people here...would have liked it better if I was just here all the time, like a spider in its web."

Birth of UCSD

Of all the grandiose visions that Roger plotted and played out, none required more guile than the creation of the University of California campus at La Jolla. With the Navy in Washington, Roger had carefully observed how power was built and used. He had seen power displayed for better and worse in the academic community, and been emboldened by his success in representing his faculty in the fight against the university loyalty oath. Yet only a person of towering conviction and persuasive fervor would have prevailed against the bitter opposition that confronted his obsession with building a rare university. It was a task he had approached, Revelle said later, “with more enthusiasm than knowledge...(as) with most things one does for the first time -- making love, becoming a father, getting a Ph.D.”

Arrayed against him at one time or another were the Academic Senate of the University of California, the United States Congress and the Navy, his home community of La Jolla, and even his neighbor Jonas Salk, who had become a folk hero with his discovery of the polio vaccine. In the early 1950s, with missionary zeal, Roger had begun to urge his fellow townspeople through public speeches and as president of the La Jolla Town Council to abandon a La Jolla Real Estate Brokers Association restriction on property deeds intended to keep out “any person whose blood is not entirely that of the Caucasian race.” With the Supreme Court moving in his direction, his message to the community soon became “to make up their minds whether they wanted a university or an anti-semitic covenant. You couldn’t have both.”

Within the decade the restriction was formally excised. By then Roger had made a typically practical response of his own, garnering the support of eighteen colleagues to buy 42 acres of oceanview residential property adjacent to the campus that they named Scripps Estates. A rugged canyon was preserved and the remainder was subdivided into 42 homesites that were offered at cost by lot “to make it possible for present and future staff members to build and own their own homes.” It was the conscientious geologist and engineer Jeff Frautschy who carried the day-to-day burdens of this venture -- just as, throughout Roger’s life, other men and women gave unflinching support to keep things running smoothly during his frequent absences and distractions. “Beginning around 1956, most of my attention was given to [the planning of UCSD] and I kind of neglected the internal problems of Scripps. I didn’t neglect the external problems so much.”

In his battle for a new university campus close to Scripps, Roger’s deadliest foe was the unrelenting Regent Edwin Pauley, whose invisible lines of power were built from an oil dynasty. Pauley was a more patient antagonist than Roger, and nearly succeeded in persuading Regents to build the campus at some other site. He was “a very powerful Regent, a big, tough man and sort of a buccaneer...his idea about how to stop a campus down here was to [propose that] it [be built] in Balboa Park.” But Roger’s early fascination with authority as the instrument of power had matured, and he had added wiliness to his repertoire. Beneath his exterior of warmth and charm, there now lay Machiavellian cunning.

Roger had many reasons for wanting that university on Torrey Pines Mesa. Some of the doctoral work for his oceanography students had to be administered through UCLA, 120 miles away, and he was painfully aware that his students weren’t getting the highest rankings. Students needed easy access to a science-oriented institution, and Roger

longed to be rid of Los Angeles oversight. He sought to expand graduate training at Scripps and believed that would win support from San Diegans as their aircraft industry faded and their economy declined. He found an ally in John Jay Hopkins, president of General Dynamics, who had suggested a university campus at San Diego in 1954 as he began making space missiles in San Diego and planning to build his General Atomics division on the mesa. Roger gathered allies like a director assembling a production. When a distinguished La Jolla summer stock company, La Jolla Playhouse, appeared to be homeless and doomed, he convinced the university to provide a campus site for it. The cultural arts, he said, were vital in attracting the kind of scientists he wanted at La Jolla.

When multiple sites began to be discussed, threatening to jettison his La Jolla hillside, local citizens joined the fray. In 1955 the Republican assemblyman Sheridan Hegland introduced legislation to authorize a San Diego campus. The newspaper publisher Jim Copley boosted Revelle's site. The attorney and ex-officio university regent James Archer did too, but Roger never trusted him after they clashed in the loyalty oath fight. "One terrible night at our house...in the middle of the loyalty oath controversy, Jim Archer drank a whole quart of my whisky...I drank some of it, of course, too...We were arguing about the loyalty oath problem, and he said that these professors should certainly be willing to sign an oath saying they weren't Communists."

Despite the university-wide Academic Senate, which seemed to oppose anything that might siphon off funds from their own programs, the Regents voted in 1956 to build a full San Diego campus. The California Commission on Higher Education was predicting a state population of 50 million by the year 2020, and more than one new campus might be needed. President Sproul named Roger to head a committee, which promptly proposed a San Diego plan extraordinarily rich in its faculty ratio: one for every 3.2 graduate students, one for every 5.8 students overall. Since the University average was one for twelve, the outrage of the old-line Academic Senate was heard again. Then Pauley proposed that UCLA handle planning for the San Diego campus. Roger was appalled and impetuously told the Regents the idea was "preposterous," and the proposal died. With Roger a persuasive voice at City Council, San Diego voters deeded over the first of several parcels of choice pueblo grant land that became part of the campus, a gift that proved to be one of the wisest of civic investments.

As the legislature debated the campus and Clark Kerr succeeded Sproul, Roger fleshed in his vision with a paper that he delivered at Princeton three days after Christmas of 1958. He got off to a Revellian start by challenging Jacques Barzun, a prior speaker, for what Roger blithely called his "denunciation of originality and creativity in the university," and said Abelard and Thomas Aquinas would have left the room saying, "This is where we came in." He called for a contemporary university rich in basic research with an activist agenda for solving societal problems, "a cathedral of our modern society...to which all men turn to find the meaning of their lives." Roger would seek professors "who do things...genuine artists and not art historians or art critics." He would start with graduate departments, from the top down, desegregating the sciences and humanities and social sciences to form a critical mass for an interdisciplinary approach to issues. Months later, as the Regents widened their view of a general campus, Roger adjusted his own to a campus with a dozen "little universities side by side," each with

about 2,500 students and offering undergraduate and graduate degrees. He longed for interdisciplinary collegiality, not the rigidity of entrenched departments.

Suddenly Pauley was at it again, attacking Roger's site as blighted by noise from Navy jets at nearby Miramar Naval Air Station. To make his point with a flourish, Pauley flew some Regents to his private island in Hawaii and arranged a thundering military flyover from a nearby airfield. By now bad blood between the two men was so apparent that some thought Pauley was more intent on reining in what he saw as a runaway ego, an arrogant man trying to exert excessive suasion over the Regents. Even some of Roger's allies conceded that his rhetoric often appeared overblown and his reactions impetuous.

Pauley's acrimonious last stand came at a Regents meeting at Davis in October of 1959, when he argued that Regents had approved the campus without adequate noise study. University architects had said insulation from Miramar jet noise would add no more than two percent to campus construction costs, but Pauley countered that his architect Charles Luckman had computed the cost would add ten percent. Roger had a copy of the Miramar noise file at the meeting, and during a recess he briefed President Kerr. Scripps Memorial Hospital was rising even closer to Miramar than the campus, and its directors had been advised that insulation would add only four percent. An outraged Pauley asked who had made that estimate; Kerr told him it had been the hospital's chief architect: the same Charles Luckman.

In a display of uncompromising obsession, Roger stood at an easel loaded with charts, pointing out that the university's Riverside campus was about as close to an air base as Pauley's Hawaiian home, and so were the state universities of Minnesota and Arizona. It was over. A motion was made to get on with the La Jolla site. In the vote that followed there was only one nay, that of Pauley. Roger had saved the university but humiliated his opponent; in defeat, Pauley would extract a final revenge.

Roger next faced conflict at home. "Jonas (Salk) decided that he wanted the best piece of land that we had. It was much more important to get Salk here than to get the university here, according to a lot of people..." In the end the university received about 1,000 acres for the campus, much of it deeded as a gift from the city of San Diego, another 545 acres of former San Diego pueblo land from the Marine Corps. Salk received the disputed 70 acres he sought, the site of the Salk Institute.

Shaking off anger, Roger plunged on with his masterwork. He began recruiting a dream faculty for his dream campus. His timing was lucky and historic. "We could not have started the new university five years earlier, and we could not have succeeded five years later." The westward tilt of American migration was just being recognized, but it had not yet made inroads on established Eastern and Midwest faculties. Within five years Gerard Piel, a New York publisher with an eye on California as a Salk Institute director, announced that his journal *Scientific American* had fifty percent more subscribers in California than in New York state. Eastern academicians seemed puzzled by the statistic. Roger sensed potential in this westering.

Harold Urey, who had won the Nobel Prize for his discovery of deuterium in 1934, was facing an unwelcome retirement at the University of Chicago at 65. Urey's interests, ever shifting among disciplines, included the nuclear research that Frederic de Hoffmann was undertaking at General Atomic. So Roger flew to Chicago and told Urey and his wife Frieda about the coming opportunity for academia to try again and get it right: a fraternal body of exceptional and proven researchers without the barriers and

infighting of established institutions, men and women who were restless and confident enough to start over, risk-takers who were innovative enough to make it happen. In 1958 Urey accepted appointment from the University of California as University Professor of Chemistry, passing up the established departments of Berkeley and UCLA to join Roger. It was Urey, described by Robert Hutchins as the “salt of the academic world,” who set the faculty mold and first alerted the academic world that something astonishing might lie ahead at the University of California at San Diego.

When Roger brought home a Nobel laureate as his first catch, San Diegans began to sense the possibility of civic reorientation that Roger had held out as their reward from the new university. White-haired and folksy, Urey was the ideal groundbreaker. He rejected the temporary office that Roger arranged on the Scripps campus because he thought its ocean view would distract him from work. When Roger asked him to schedule a public lecture the hall grew so crowded that a fire marshal ordered several hundred locals outside, and Urey repeated his lecture for them. At a private elementary school he spent an hour with nineteen pupils, telling them that school is a place to be happy. “I know,” he said, “because I have been in school all my life, and I have been happy.” He was the toast of the town.

Everything began falling into place. Scripps Clinic was moving to Torrey Pines Mesa near General Atomics and vastly enlarging its research institute. Scripps and Salk Institute could offer dual appointments or adjunct research roles to enhance the synergy of the new campus. Jim Arnold, a Manhattan Project veteran at the age of thirty-five, had left Chicago for Princeton, but Urey and Roger convinced him to move west to build UCSD’s chemistry department. In the Cold War, Roger began to see the research role of the new campus as pivotal to national security, just as he believed the secret research at Scripps was essential to the free world’s submarine capabilities. Arnold was a case in point. His doctoral dissertation of 1946 remained classified.

When Roger met the young physicist Keith Brueckner over lunch at La Valencia Hotel, he offered him a professorship. “He was so vigorous, and so bright, and so enthusiastic, and at the same time had such good taste...Starting a new physics department, in a non-existent university, in a remote resort town, where he would be surrounded by oceanographers, was just the kind of far-out gamble that he would be completely unable to resist.” Brueckner moved west from the University of Pennsylvania and became a fervent recruiter whose arrival on other campuses sent administrators into black moods. As much entrepreneur as Roger, and wise in the ways of national security, he talked glibly of supplementing university salaries with federal research grants. A science mystique was building around UCSD before it opened. De Hoffmann had launched a top-secret summer conference at La Jolla with the sponsorship of the Office of Naval Research, and it was drawing the world’s most eminent scientists. As a \$1.5 million grant from the Atomic Energy Commission to the campus was announced in 1960, the geneticist David Bonner left Yale to join the faculty. He promptly arranged an on-campus symposium of researchers in enzyme synthesis whose papers were published by the National Academy of Sciences.

Now Roger had a team of recruiters as aggressive as he, and they flared out across the nation and even “plucked off some of (Bell Labs’) stars.” Roger called the University of Chicago “a sort of patsy,” and one of its faculty observed that “whenever we heard (Roger) was visiting, we knew another faculty member (Joseph and Maria Meyer among

them) was about to leave town.” Bringing superstars was both the best and cheapest way to build a faculty, Roger argued, because they often brought along funding grants. When a prospect had been showered with “affection and eloquence” at a dinner party (the Revelles’ oceanfront home was the favored site), Roger would lead a late evening walk on the old Camp Callan land that was to become the north end of the campus. Perched on a fallen brick chimney, he pointed toward sea and mountains and, in his most mesmerizing tones, talked of the unprecedented university that would rise around them. Roger’s recruiting score grew legendary. Others “resisted our siren ways”; among them were Ed Frieman, who later served as director of Scripps Institution, and William McElroy, who became UCSD chancellor.

But in February 1961, Roger’s euphoria was dashed. An agitated Kerr told him the Regents would not be naming him UCSD’s first chancellor. They had chosen Herbert York, a UC Berkeley graduate, a 39-year-old physicist from the Department of Defense. He had been a Manhattan Project prodigy and worked with Hugh Bradner of Scripps on Operation Greenhouse at Eniwetok, then directed the Lawrence Livermore Laboratories. Roger was shattered. “He deserved [the chancellorship],” Kerr said years later. But Pauley was collecting his revenge, and there was enough additional opposition that Kerr would not take the fight to the Regents. Opponents cited Roger’s cavalier administrative oversights, his perceived arrogance, his living standard as a wealthy Scripps spouse, and possible conflicts of his real estate investments.

Roger wrote Kerr: “During the past several years, you have asked me to do a nearly impossible task: to manage the second largest research laboratory in the University, with its worldwide responsibilities, and at the same time to build a new School which would be the embryo of a great university, under circumstances that made it impossible to obtain adequate assistance. Evidently you and many of the regents consider that I have failed in important aspects of this task, and I agree...(But the faculty and) most scholarly opinion in the country consider that I have succeeded in the fundamental and critical aspects, and I hope in the long run you and the Regents will agree that this is so.”

Indeed, the campus came to rank as the most distinguished one built after the Second World War, perhaps in the twentieth century. While remarkably akin to his original vision of “something like” a publicly supported Caltech, it became a full university built around stellar scientists and open from the beginning to undergraduate study. But Roger was still stinging with disappointment. Within a month he escaped La Jolla for an adventure off the coast of Mexico that he had dreamed of for years.

Project Mohole

Always bored by small talk, Roger was happiest when considering the untried and unorthodox. He had been a ready candidate for a light-hearted gathering -- a "white-wine breakfast" -- at the home of Judy and Walter Munk in 1957 to discuss future affairs of the American Miscellaneous Society (AMSOC), a group once called "a mildly loony, invisible college of otherwise mature academicians...exceedingly democratic, but harmlessly anarchic." Earlier, during a National Science Foundation meeting, Munk and Harry Hess of Princeton had been yearning for challenge and excitement; what would be the most intriguing and significant project they could think of, regardless of cost? Munk suggested trying to drill through the sea floor to mine a sample of the earth's mantle. They would seek funds under the banner of AMSOC, "a group with no declared purpose or legal standing." Soon they were joined by Roger and other Scripps scientists including Bill Bascom, a "restless, cocky oceanographer...with unconventional ideas about deep-water engineering." Their first proposal, submitted in all seriousness to the National Science Foundation, was "to drill a hole through the bottom of the sea" to try to reach, for the first time, the earth's mantle. "Probably the best place to do this is under the ocean," Roger wrote, "...the mantle there is only about three and a half miles below the sea floor; whereas it's about twenty miles deep under the continents." The project seemed just right to Roger. Not even the petroleum industry had yet attempted deep-sea drilling.

In time a bleak letter of rejection arrived ("the NSF was not known for its sense of humor"), but by then they had grown passionate about their quest. Reluctantly they ditched the AMSOC sponsorship and, as members of the National Academy of Sciences, resubmitted the proposal on Academy stationery. It was authorized, funded, and named for the Yugoslav geologist Andrija Mohorovicic and the eponymous Mohorovicic discontinuity, the irregular line separating the earth's crust from its underlying mantle. Quickly its name became Mohole.

In March of 1961 an ungainly drilling barge named CUSS I lurched and rolled out of San Diego Harbor to test the scientific techniques of the American Miscellaneous Society. Seemingly against its will, the craft was tugged south toward Guadalupe Island, 150 miles off the coast of Baja California, a site selected by Russell Raitt and George G. Shor Jr. as an "interesting spot geologically" and well off shipping lanes. CUSS memorialized the oil companies that owned it: Continental, Union, Shell and Superior. On board were some of the expedition team of offshore oil drillers, oceanographers, geologists, paleontologists, seismologists -- and a nerveless pilot whose duty was to strive to hold the rig steady in fourteen-foot swells and twenty-knot winds. His only controls were four 200-horsepower outboard motors (a system devised by Bascom), two on each side of the hull.

The novelist John Steinbeck came along for *Life* magazine, calling himself an amateur oceanographer. "CUSS I," he wrote, "has the sleek race lines of an outhouse standing on a garbage scow. Actually it is an oil rig, straddle-legged over a hole cut through the middle of a barge 260 feet long and 48 feet wide." The derrick rose almost 100 feet, and raked back and forth across the sky like a hellish metronome. After four tormented days, "lighted up like a Christmas tree," CUSS joined the *Horizon* and *Spencer F. Baird*, and Scripps people including Revelle, Munk and Roger's teenage son Bill. No

one knew what to expect, certainly not the founders of the American Miscellaneous Society. The drilling proved to be harshly noisy, around-the-clock. Nobody slept much. Steinbeck wrote poignantly of galley cooks attending lectures by Bascom and William Riedel, and of the gentleness with which Roger explained the significance of 20-million-year-old core samples to a roughneck who was risking his life to drill from a wildly thrashing platform.

On Easter Sunday, April 2, Roger stood joyous on deck. From more than two miles below, boring 600 feet into the ocean floor, a drill brought up a core of stark blue basalt with extrusions of crystals. The ludicrous platform and its technology worked. Project Mohole could proceed. Steinbeck wrote that "CUSS I's drilling has about the same emphasis as Columbus' first feeble voyage of discovery...[the] first touching of a new world...And the men who have dreamed this plan and fought it through have tight smiles of deepest satisfaction." President John Kennedy wired congratulations on an "historic landmark in our scientific and engineering progress."

Mohole was no longer just a whimsical scientists' hunch. The National Science Foundation turned to the construction firm of Brown and Root to drill deeper, on into the earth's mantle. But scientists and bureaucrats sparred over methods and locations. Congressional infighting dragged on. About five years and \$20 million later, to Roger's chagrin, Mohole was abandoned. Munk concluded: "It's one of the lessons in our lives -- Roger's life, my life -- that if you really believe in something, you have to be willing to stay with it...in a close way. It was an important lesson and we haven't made that mistake since."

That summer Roger was recruited "rather vigorously" to be chancellor of Washington University in St. Louis, which he eventually rejected because the university's esteemed medical school was outside the chancellor's control and because, unlike Berkeley or Harvard, with their yeasty student neighborhoods, it was a "city university" where "most of the students were commuters." Ellen was against the move. "It's the only time I ever got involved in one of his professional decisions," she said. "I felt strongly that it was too spur-of-the-moment, too big a commitment when he was still hurt by the rejection of UCSD."

But Roger's people prospered; one busy afternoon after Maria Mayer's Nobel Prize had been announced, a news photographer asked if she would pose with the long equation on the blackboard behind her. "Certainly," she said. "It's really nothing, just something I scribbled up there for CBS." When Roger heard that story, his face exploded in a grin. "I think the campus must be working," he said.

International Years

Early in the Kennedy years, Mohammad Ayub Khan, a Sandhurst-trained general who had seized the recently-partitioned Pakistan in a coup, appeared before Congress to plead for weapons and aid. West Pakistan's agricultural crisis was desperate: farmlands were waterlogged and saline, dooming hundreds of thousands to famine. John Kenneth Galbraith advised against arms, and so Kennedy sent Roger Revelle.

Jerry Wiesner, Kennedy's science advisor, had been expecting Roger from California any day to serve as the first science adviser to the Department of the Interior under Stuart Udall. Roger had sought the post, eager for a fresh challenge and high-level approbation. As he took leave from the Scripps directorship, physicist Fred N. Spiess stepped smoothly in.

"Roger's an oceanographer," Wiesner advised Kennedy. "So he knows about salt." But of course he didn't know about salt, Roger lamented. "Nothing, nothing. Zero, zero." His disclaimer was not entirely true. In 1948 the California water attorney Phil Swing had brought Roger into a litigation in which he represented farmers in the Tijuana River Valley on the Mexican border. So little water was coming down the river, they alleged, that saline intrusions had developed into their wells. Roger's research led him to write a paper that became a standard in water law, citing scientific criteria for judging whether salty ground water was sea water or not.

For Pakistan, Wiesner brought in experts from the recent Harvard Water Project. Roger involved his oldest friend, the geologist Rollin Eckis, then president of Richfield Oil. From Scripps he brought John Isaacs, whom he called his idea man. "He literally produced one idea a week all his life. A fantastic man, the kind of assistant to have." The resulting 20-man team from American science and industry soon became as familiar with the flood plains of the Punjab as with their back yards at home.

"It's like driving over the ocean," Roger said. "It's flat, a sea of green, not blue...hundreds of miles of flat flood plain." Its mother lode is the trans-Himalayan Indus River, which Alexander the Great crossed in an end run around the army of elephants that opposed him -- a story that Roger learned in detail and loved to retell. It was the Indus Waters Treaty of 1960 between Pakistan and India that had set up the Aid to Pakistan Consortium of Western nations and led to Roger's mission.

The team flew to the Punjab in the fall of 1961. Roger's first view from the air appalled him. "These canal colonies which were on this (British) grid system looked as if they'd been struck by a disease. Some had literally disappeared and in others there were just a few houses left. The farmers had been starved out. They couldn't grow any crops

in this salty soil. Large areas were flooded. There was standing water.” But meeting with Ayub Khan, the team was “very well entertained,” and Roger launched another rainbow of connections. Their host Zulfikar Ali Bhutto, later to become president of Pakistan, “had a beautiful Persian wife, and his daughter I later taught at Harvard, Pinky Bhutto.” Bhutto himself “was about as close to (Boston’s) Mayor Curley as you could get and be a Muslim instead of a Catholic.”

In the first days the team stumbled on a discovery that Roger decided was “the payoff for the whole project.” As Roger led them through a cornfield, Charles Bower of the U.S. Department of Agriculture picked a corn leaf, studied it, and said, “This corn is not suffering from salt in the soil. It’s just not getting enough nitrogen.” But with the more vital crop of wheat, they soon learned, it was both, and a vast pumping system was augmented with fertilizer and “miracle wheat” seeds.

Isaacs recorded an encounter between Roger and a gnarled Pakistani farmer standing in tattered robes on the Chenab floodplain:

Roger approached the lonely figure and extended his hand in greeting. To our surprise, the old fellow fell to his knees, grasped Roger’s great hand in both of his, and began to kiss it. I saw tears of distress come to Roger’s eyes, and he asked gently and with a rare timbre of strain in his voice for the interpreter to ask the man to stand up and shake hands. The farmer did, and he and Roger spoke for some time about the floods, the salt and the famine.

Such farmers, assured they would soon harvest two crops instead of one, dug 70,000 tube wells to control the floodwaters. The Revelle Report recommended that both the Punjab and Sind farmlands be rebuilt a million acres at a time. Ayub Khan won a loan from the West to build the Tarbela, the largest embankment dam in the world. “The main thing we did,” Roger said, “...was [insist] that this could be a Garden of Eden.” Within ten years wheat production in West Pakistan doubled.

Roger built ties within the Kennedy administration and served as a Peace Corps advisor. He attended the centennial observance of the National Academy of Sciences, which Kennedy addressed in Washington a month before his death. Wiesner and Roger had been involved in writing a draft of Kennedy’s speech. “He started reading this speech and after about ten minutes he gave up and just started talking...He didn’t need us.”

Adrift from California and the university he had founded, Roger served on United Nations committees and represented the State Department on the UN Committee on the Law of the Sea. But he found the UN often “clumsy” and its work “ineffective.” The Pacem in Maribus conference took him to Malta for several years. Such international exchanges kept Roger’s probing mind busy and he enjoyed expanding his roster of world friends -- whether princes or dirt farmers. He wanted to understand all of Earth and try to make it work better.

The Pugwash conferences fit these passions, and he became a “Pugwashite”, appearing wherever they gathered: Stockholm, Brussels, Addis Ababa, Sochi on the Black Sea, Stowe, Vermont. Named for its first meeting site -- Pugwash, Nova Scotia, in 1957 -- this gathering of scholars was initially prompted by Bertrand Russell, Albert

Einstein and others concerned with disarmament and world security. It broadened its scope to examine the social responsibility of scientists toward population growth, economic development and environmental corruption, concerns that Roger's Washington years made increasingly close to his heart.

He attended his first Pugwash at the invitation of the nuclear physicist Leo Szilard, who wearied of the "set speeches" being delivered by Russians and Americans in those Cold War years, yet found value in conversations during "walks in the garden." Roger never forgot "a typical, screwy Szilard idea" to "trade cities" with the Soviets to avoid escalating tension into global destruction: If the Russians bombed an American city, then the U.S. would, by agreement, bomb a Russian city of similar size and importance.

In 1963 Pugwash convened at the majestic Lake Palace Hotel on Lake Pichola in India's Udaipur. Roger met Prime Minister Nehru, then quite ill, and his daughter, Indira Gandhi. He got off to a bad start with Mrs. Gandhi "because I said, without really knowing much about it, that there'd been very little improvement in the Indian villages since independence." They met again after she became Prime Minister in 1966, when colleagues noted that she may have been the only head of state to turn her back on Roger.

Still, that conference led Roger to a decades-long involvement in India. He became the American member on India's national education commission. From 1964 to 1966 he spent about one month in three in India, forming bonds that brought him back in later years, sometimes bringing along a grandchild. Yet when he heard friends say, "Roger loves India", he was puzzled. "I would not say I 'loved' it. I find that I'm fascinated by it. It's a kind of...universe of people which is just like mankind in general, but instead of four and a half billion of them, there are only 700 million of them. There are so many Indians that whatever you say about human beings you can say about Indians. They're bad and they're good, they're mean and they're generous, they're idealistic and they're very materialistic. They're just people." He ranked India's handicaps as "poverty, ignorance, the caste system" and the preference of college students for civil service jobs over the teaching profession.

Pugwash expanded his friendships and interests. A decade later at Venice, he and Harrison Brown proposed an International Foundation for Science to provide grants to young researchers in developing countries, much as the National Science Foundation does in the U.S. The proposal was eventually implemented. He met Margaret Mead at a Pugwash session in London, and they went on to work together as top officers of the American Association for the Advancement of Science. Pugwash also focused Roger's thinking about world affairs during the Cold War. His natural inclination, he said, was that "the role of the scientist is to try to think through the problem rather than to try to take a political stand...I'm in favor of unilateral disarmament...What we're risking is Western civilization...the only one that's ever given mankind hope for the future. So Herb York says I'm right in principle, but politically I don't make any sense."

To Harvard

Roger returned to Scripps as director in 1963 as invitations were going out to the first freshman class at UCSD. York, who had sparred with the academic senate and had

not entirely won over disappointed Revelle loyalists, was stepping down as chancellor. Roger wanted desperately to stay in San Diego but felt it would be impossible unless he succeeded York. He told Kerr that Harvard had offered him a chair endowed by Richard Saltonstall in which he would head a new Center for Population Studies. It was an outgrowth of his work in Pakistan, and some colleagues in that project would be involved. Kerr, aware of Roger's administrative weaknesses, asked how he would feel about the Scottish-born historian John Semple Galbraith as his vice chancellor, and Roger warmly agreed. But when he telephoned Kerr one spring weekend to push for a decision, he was told Kerr was "out poisoning plants and can't talk now." Roger could no longer avoid a sense of professional crisis. He had thought "the antagonism [to him] might have died down, but it hadn't -- in the Board of Regents, apparently." Kerr brought Roger the news, and the second rejection was more painful than the first. He turned to Carl Eckart as "my sort of father confessor," and the gentle Eckart tried to discourage him from moving to Harvard. "It may be," Eckart told him, "that the population problem will just solve itself, just go away." In fact, as Roger later recognized, the postwar baby boom was ending abruptly. But in many parts of the world the annual birth rate was rising to a disastrous four percent of population. "I thought the problem was really urgent. I didn't know much about it, but I learned a lot later."

Kerr suggested Roger might retain his professorship at Scripps. But Roger retired from the faculty, writing Kerr that it would be an act of bad faith with Harvard. The physicist William Nierenberg became director of Scripps and Roger began thinking more of moving around the world in search of societal problems that science might fix. He was flattered to be recruited by Harvard, which he considered the preeminent university of the world, and Harvard had acceded promptly to his stipulation that the Center be interdisciplinary and university-wide, not lashed to the School of Public Health. But years later, knowing Harvard almost as well as Berkeley, he ranked Berkeley first. "I didn't want the [Harvard] job very much," Roger recalled. "I wanted to stay at UCSD." From Harvard, Roger would manage to maintain working ties with his Scripps colleagues and their research.

In Cambridge, Ellen settled them into an Italianate house just off Brattle Street on Larch Road in a neighborhood of stately older houses. As usual, when moving time had come, Roger was away. On campus he installed the new Center for Population Studies in a century-old, three-story house at 9 Bow Street, a former boarding house. Its dining table became the focus of its conference room, and old Cabot family furniture was dusted off and moved in from a Harvard warehouse. For decor there were small carvings, "so full of joy," that Roger had brought from India. Eager for the conviviality of fresh minds and a dry martini, he joined the Tavern Club and the Saturday Club, a monthly luncheon club founded by Nathaniel Hawthorne and Ralph Waldo Emerson to launch *the Atlantic Monthly*. To Roger the Saturday Club served well enough as the shrine of Boston culture. Members met monthly at the Union League Club for good wine and conversation and a free lunch, long ago endowed by a member of the Forbes family. Ellen busied herself with three women's clubs, and reveled in all her Cambridge life but the summer heat. On campus Roger became a member both of the Public Health faculty and the more revered Arts and Sciences faculty. At lunch he made straight for the long center table at the Harvard faculty club, where he might "sit next to anybody from any part of the university and talk to them, and it doesn't have anything to do with what you're supposed

to do.” He wondered wistfully about his dream of collegial accord at UCSD, of crossing the barriers of disciplines, and longed for the time he might find such a faculty club among the eucalyptus trees of La Jolla. As he had felt the sense of student place so keenly at Telegraph and Bancroft in Berkeley, he now made a point of striking up conversations with strangers at Harvard Square. A transfer from the faraway West Coast, he built a Yankee base for good fellowship.

John Crayton Snyder, a Pasadena High School classmate of Ellen’s who had become the expansion-minded dean of the Harvard School of Public Health, of which the Center was a part, was hoping her suave and persuasive husband would spend much of his time raising money. The dean got his first whiff of Roger’s independence when, over Snyder’s remonstrations, Roger had accepted the appointment on India’s education commission. India represented the freedom Roger needed to search for new learning and friends, and it was unarguably a means of studying populations. Yet it was one thing to study farmland, and another population. “The Indians were getting quite independent. They didn’t like to have foreigners working on their population problem.”

It was a time of explosive public interest in birth control and family planning. Roger insisted that his new Center not be involved at that level, and he “antagonized quite a few people, the Planned Parenthood types...(and) the population establishment.” At such times the wide screen of his mind led Roger into carefully reasoned, scientifically diverse views that nettled those holding narrower positions. Conservatives were forever condemning him as liberal and liberals chiding him as a turncoat conservative. In population studies he refused to side with biologists like Paul Ehrlich, “who thought it was terrible that human beings were going to breed themselves into a catastrophe.” Biologists worked with animals, and Roger believed human characteristics changed the equations and skewed their conclusions. “So I never had any faith at all in the biologists, at least after I got started in [the population] business.” Public health people saw population explosion as depriving children of adequate food and good health. There were others whom Roger viewed as racists, concerned that “there are too many (minorities) propagating in less-developed countries.”

Roger established his own more rounded perception: that the population problem “can’t be separated from the problems of poverty and underdevelopment, or effective resource utilization, but must be looked at in historical perspective (involving) many of the different aspects of human scholarship and human science, not just administration of contraceptives.” Demographers dominated population studies and Roger, considering their discipline predominantly a mathematical one, sought to humanize the curriculum.

He was urged to lecture frequently and reached a pace of two or three a week. There was growing student interest (“nice old guy,” he recalled as his first student rating, “but puts people to sleep”). His informal, all-day Saturday seminars became intimate cram courses attended by doctoral fellows, including foreign students whom he especially sought to encourage. His philosophy in population studies is set down in a volume published in 1971 by the Johns Hopkins Press for the National Academy of Sciences: Rapid Population Growth: Consequences and Policy Implications. It is notable as a calm and objective view of a subject often emotionalized. Roger’s principal writing is the summary of about 100 pages; the rest is the work of an Academy committee he organized, led by a Harrison Brown protege, Murray Todd. As a textbook, it has taught a generation the ethics of population policy: the necessity to avoid violating local mores,

and the futility of population control efforts without government policy that fosters food production, education, and the status of women.

At Harvard Roger was hard to classify and impossible to dominate. But his friend Dean Snyder retired, and his successor sought to revitalize the center with an inflow of young scientists. A committee of demographers was appointed to review the population center's operation, and Roger felt he was about to be replaced as director. About that time he became president-elect of the AAAS, and his dean "began to realize that I was in fact one of their shining lights. So he dropped that idea. Also since I was about to retire anyhow."

In 1974 when Roger turned 65, the age when Harvard limits professors to half-time, Roger and Ellen began spending part of each year again at La Jolla. Walter Munk urged him to return as a half-time professor, the only option open because he had retired from the faculty a decade earlier. For his final lecture at Harvard, 300 students appeared, and a score of faculty friends, with the traditional applause climaxing the hour. He recognized scores of students who had attended the social evenings that Ellen and he hosted, challenging the established underclass wisdom that faculty and students should not mix.

In La Jolla the chancellor William McElroy asked what Roger would like to do. To be professor of Science and Public Policy, Roger responded, and that was it. He returned and "worked full-time regardless. They were very nice to me. They gave me a secretary and an office, allowed me to teach. It's wonderful. I love it."

Roger's years began to fall into thirds: a fall term at Harvard, spring at UCSD and three months or so pursuing his only "hobby": traveling to a farflung pocket of the world, always with a mission. In February of 1977 it was Pokhara, at the foot of the Himalayas in Nepal. The assignment, from the Agency for International Development, was to enhance crop production and develop inexpensive hydroelectric power. Arriving rumbled on the weekly flight from Kathmandu, he carried his usual bulging briefcase of "essentials": a carton of cigarettes, a bottle of whiskey and a cram of technical journals and books on the problem at hand. His first question for his awed Nepalese welcoming party: "Do you know anyone here who might be my size? My bags got lost in Dallas." Silver-haired and beginning to stoop, he still stood a foot taller than his hosts.

His team included agricultural specialists from Alabama and Ohio and hydroelectric engineers from lands with similar mountainous terrain: Switzerland, Japan, Norway -- and from Montana, a large man who lent Roger a cowboy shirt and slacks. They gathered in Roger's hotel room for beer and cashews and his idea of a briefing: a rambling discussion of Nepalese wedding customs, cooking styles and the royal family -- as well as the deforestation and terracing that had led to landslides and sediment-choked rivers.

A disciple of small-scale technology for developing nations, he was appalled when shown a huge concrete dam built to accommodate the maximum flow of a river that runs nearly dry for eight months of each year. Eventually his Nepal report for AID espoused village water wheels and three-kilowatt generators as power sources for irrigation pumps and fertilizer manufacture, along with wind and solar power. Before the report was published, newspapers reported that Nepal might receive aid for "village

hydropower projects” from the People’s Republic of China. A friend watched as Roger read a clipping and laughed. “As long as the work gets done,” he observed, “Roger doesn’t care who gets credit.”

Fame and Peace

Over tea in Pokhara, A. B. Shrestha, who directed Nepal’s National Council for Science and Technology, had spoken of Revelle as a *jivan mukti*. It is the Hindu phrase for those with inner peace at the final level of earthly existence, who choose not to rest in Nirvana when they die but to re-enter society and share their knowledge. Roger drew strength in the final decade of his life from teaching at the university he had founded, never relinquishing his sense of fun. Busy at the age of 75 with classes in marine policy and population, he took a briefcase of examination papers to grade as he flew to Washington to receive the National Science Board’s Vannevar Bush Award for scientific statesmanship. But he left the briefcase in a taxi, he confessed later to his class, and posted a cash reward for its return. In two weeks the briefcase appeared and Roger dutifully read the exam papers, awarding four A+ grades; no student fell below C.

His bonding with the campus grew ever closer. During commencement at the UCSD college that bears his name, he sought each year to shake hands with every male graduate and kiss every girl. He kept count one year and it came to about 150 kisses. “It was better this time. Two or three years ago so many men were wearing long hair that I didn’t know I was in trouble until I felt the beards.” His attention to the classroom never waned. When Caroly Shumway defended her doctoral dissertation at Scripps, her grandfather Roger watched, beaming, and acclaimed her the institution’s first third-generation Ph.D. Anticipating an era of Asian ascendancy, he lobbied successfully at UCSD for a graduate center for Pacific studies. “It is the area of the future, and business management is its most pressing need.”

Among the diverse Roger Revelles -- scientist, teacher, writer, statesman, family man, bon vivant -- was the local citizen, reveling in bonds of family and community. As

he had sought the arts and letters faculty of UCSD, Roger had conceded a problem in attracting academicians to a city whose “best-known cultural attraction was a first-rate zoo.” When San Diego Rotarians named him “Mr. San Diego” in 1988, he startled them by issuing a stinging challenge to rise above civic mediocrity and work toward the city’s potential. He had long hoped San Diego might come to merit rank as a Boston of the West Coast, but continuing conservatism and complacency discouraged him. Much as the Scripps had done in an earlier generation, the Revelles -- using her Scripps-related newspaper inheritance and his real estate and oil investments -- enhanced the young city’s cultural arts. They helped to rescue the San Diego Symphony Orchestra from collapse more than once and supported the summer festival of the La Jolla Chamber Music Society. Roger had lobbied the Regents to provide La Jolla Playhouse a site at UCSD, and he and Ellen were generous patrons as it grew into a major regional theater. Among his happiest diversions after returning from Harvard was an amateur theatrical group called the Playreaders. Two Scripps stalwarts, Hugh and Marge Bradner, lured Roger into his first role as the breathless delivery man in “Barefoot in the Park.” Ellen witnessed his ascent to stardom: “He only had a two-word part, ‘Sign here!’, ‘but he practiced for days, in all tones, all over the house. When they applauded, he was hooked.”

He reveled in the risk of new ideas, whether in scientific conferences or beneath the redwoods with compatible colleagues at the Bohemian Grove summer encampment. (“He could be a snob,” one of his lifelong intimates conceded, “but usually in a good cause.”) In 1982 Walter Cronkite gave a speech at the Grove challenging basic tenets of the American nuclear deterrent. He received spirited applause from a largely conservative audience. “Afterwards I felt the sky grow dark and a towering shadow came across me,” Cronkite recalled. “I looked up and there was Roger, one of his long arms draped across my shoulder. ‘They applauded, Walter,’ he told me, ‘because they knew not what you said.’”

Roger had been lecturing at UCSD on the African food crisis in 1987 when his old friend Jerry Wiesner, then president emeritus of MIT, called and reminisced about their first trip to Pakistan two decades earlier. What Africa needed, Wiesner said, was “a young Roger Revelle,” for Roger had become a specialist in launching scientific projects in developing nations. Soon, with MacArthur Foundation funding, Roger, at 78, led Wiesner and his team of Western and African scientists on grueling ten-nation African tours to assess agricultural problems and propose a core group for grant funding. “The social and economic problems may very well be the critical problems, and I’m not sure we can do much about it,” Roger said. “But if you wait until you solve the social problems, people will starve to death.” The scientists met warm cooperation in every nation except Ethiopia, with its Communist regime. Their findings set off a flurry of attention to African famine, but Roger came away convinced that “African problems must be solved by Africans, not by Americans or Europeans.”

Through his final years Roger was a prickly but endearing mainstay of round-table luncheon discussions hosted by Helen Copley and her San Diego newspaper

editors. He dozed off during a spirited conversation one day, but five minutes later he opened his eyes to challenge a young Salk Institute geneticist on a point of logic. "I love these talks," he said, lingering with the last to leave. "I love hearing bright people probe at each other's best new ideas, no matter how crazy we all sound." The campus he had forged became a magnet revitalizing the region, luring diverse minds and elevating a town steeped in Navy and retirement into one known for its research science. As its demographics changed, San Diego came to rank first among the ten most populous cities of the United States in its percentage of adult residents with college degrees, by 1990 almost one in three. "He brought a whole spectrum of people to this little town," Walter Munk marveled. "What a man!" He had been long vindicated for his stubborn stand in building the university on Torrey Pines Mesa. As the nearby Scripps Research Institute became the largest private biomedical research institute in the world, Richard Lerner, its director, said: "Here are the results of three separate visions: Revelle's, Salk's, and ours. You could hardly put three such institutions in sight of each other and lose the game." Research and development began to throng the area, part of the dream that Roger had shared in late-night recruiting walks across a barren mesa.

The awards had been cascading in, and in November of 1990, recovering slowly from cardiac surgery, his head looming large over a shrinking body, he visited the White House to receive the National Medal of Science from President George Bush for his "work in carbon dioxide and climate modification, oceanographic exploration presaging plate tectonics, the biological effects of radiation in the marine environment, and studies of population growth and global food supplies." Roger told a reporter, "I'm not a very good scientist...(but) I've got a lot of imagination. The age of exploration of the sea was just right for me."

Always fearless, he grew outspoken in the summing-up years. Among environmentalists he was a revisionist, controversial because he placed mankind at the head of the environmental food chain: "A sensible use of the environment for the benefit of human beings," as Munk described it. As a pioneer in the study of global warming, Roger could not be ignored. He did his own thinking and reached conclusions that often outraged professional conservationists. While Americans railed against nuclear power, he called it "much more benign" than other available sources of energy. "What we ought to do is imitate the French and Japanese. They haven't got any phobias about it." He had "never been very excited about ocean pollution...I think that Jacques Cousteau is off his rocker when he says that the ocean is dying. That's complete nonsense. The ocean is the world's greatest hole in the ground, and it's been receiving the waste from the land for the last 3 billion years."

Five months before his death, wan and tiring quickly, he took the witness stand in U.S. District Court in San Diego and qualified himself as "just an old-fashioned oceanographer." He testified that coastal cities should be spared the stringent secondary sewage treatment regulations required of inland cities. Practicing rational environmentalism, he had volunteered as a witness for the city against the federal Environmental Protection Agency. The EPA found San Diego's sewage outfalls, 2.5 miles at sea, a threat to the oceans and ruled the city must spend billions on secondary treatment. A resigned City Council had voted to seek funding and the issue appeared closed when Roger and other Scripps oceanographers came forward.

“I can think of a hell of a lot of things we should be spending our money on other than secondary treatment,” he testified, “particularly because I can’t think of any good that will come from (it).” He defied a consultant who said brittle sea stars had moved away from the outfall pipe. “Fish need a lot to eat. That sewage provides nourishment for a lot of sea life.” Eventually a federal judge sided with Roger. A grateful city saluted its scientists and upgraded its overall sewerage system with its savings, leaving its ocean outfall for the fishes.

Scrappy to the end, he came to an old friend’s defense when Walter Munk seemed about to lose his underwater sound transmission experiment in calibrating ocean warming. Its presumed effect on marine mammals became the target of ranting hyperbole over the Internet. “Shame on you,” the old college journalist wrote the journal *Science*, “for publishing the farrago of innuendos, anonymous statements, and unsupported assertions...(about the) experiment carried out under the inspiration” of Munk...(The writer) gives the impression that NOAA staff members insisted on anonymity because they were afraid of retribution from Munk, who is described as the country’s “most powerful oceanographer.” In fact...my friend of more than 50 years is the gentlest and kindest of men. He is completely incapable of retribution against anybody, especially for a difference of scientific opinion.” Good science prevailed and Munk survived months of raucous public hearings to move forward.

Soon after Ed Frieman came to Scripps as director in 1986, Roger appeared in his office door, chuckling. “I got you!” he said. When Frieman had been a research assistant at Princeton, Roger offered him a full professorship to help launch UCSD, but Princeton matched the offer and Frieman stayed. Since Roger’s return from Harvard his assigned office had been on the “upper campus,” but Frieman noted that he appeared almost every day at Scripps. “He wanted to know how everybody was,” chemist Jeffrey Bada recalled. “Up on the third floor I’d hear this shuffling sound and here’s Roger, checking up ‘to see what your latest things are.’”

Frieman went to Ellen. “Do you think Roger would entertain moving back down here to Scripps?” he asked. She whooped: “He’d love it,” and Roger settled into an oceanfront office across the courtyard from Frieman, where “a constant parade” of visitors paid court. “Every once in a while,” Frieman recalled, “I’d wander in and say, ‘Roger, I need some director lessons.’ Several times he told me the story of the marauding wolf in the medieval town of Gubbio. The legend is that St. Augustine prevailed on the wolf to give up his marauding, and when the wolf died he was buried in hallowed ground. Roger seemed deeply moved by a saint’s conversion of this ferocious wolf to peace. To him it was a haunting symbol of something, but he never said what. About three weeks before he died, on the way to our last meeting in London, he detoured to Italy to go to Gubbio. It was his final quest. I never understood. Was he the wolf? What did it mean?”

The Last Voyage

He had begun his masterwork, building UCSD, with one consuming idea. “For the world of the future, great universities will be the most important of all human enterprises.” But not ivory towers. A practical man, he anticipated the emerging knowledge capitalism and the growing interdependence of science, government and industry. He believed that neither politicians nor scientists command much respect in society, and “yet between them they hold in their hands the future of mankind...Scientists are interested in power over nature; politicians, in power over people.” Science can tell us “only what can happen.” The politician “must furnish the guidance and decision that will allow the possible good to become reality and that will prevent evils.”

He towered in mind and body, in intellect and vision, in humor and charm. His successor at Scripps, physicist William Nierenberg, wrote that Roger was “the last living member of the quadrumvirate that made oceanography the grand research field it is today” -- Columbus Iselin of Woods Hole, Maurice Ewing of Columbia, and Harry Hess of Princeton. “One of his major accomplishments after the war was to persuade the Rockefeller Foundation to make a massive infusion of money into both the Woods Hole...and Scripps...to reestablish biology as a discipline equal to physics and chemistry.” He led a scientific generation as the prophet of global warming, and persuaded “no end of scientists to do no end of work,” as one journalist observed.

He prodded and goaded and gave. But when, in his view, anyone fell short, Revelle said so and tried to set things right. His fifty-year colleague Walter Munk said he “pursued the study of the planet Earth with romantic attachment and dogged determinism...Oceanography used to be the passion of wealthy amateurs who sailed big boats. It was a gentleman’s game. Roger spoiled the game but made it far better science.” Walter Sullivan of *The New York Times* called him “one of the two or three top spokesmen for science in the western world.” He was “more than a scientist,” wrote Philip Handler, who, while president of the National Academy of Sciences, shot pool with Roger at the Cosmos Club. “He was a national resource!”

His heart stopped finally when he was 82, in the UCSD Medical Center on July 15, 1991, with Ellen, their four children and Bill’s wife Eleanor at his bedside. The eulogies of children and grandchildren, his colleagues and even his physician made the services at La Jolla Presbyterian Church joyful. The Scripps community mourned him in a seaside service on campus, and then, at sunset, Roger’s ashes went on a final expedition aboard the Scripps oceanographic research vessel, *New Horizon*, waiting beyond Scripps Pier. At noon on Sunday, July 21, en route to station off Point Conception, the captain and ship’s company held a solemn service. Tennyson’s “Crossing the Bar” was read aloud, the ship’s bell tolled and Roger’s ashes were scattered astern. A lone black-footed albatross landed among them in the wake of the *New Horizon*.

EPILOGUE

Roger's office remains intact with his nameplate and his walls of honors and awards, including the National Medal of Science. With an irony he appreciated and approved in advance, the UCSD Library's automated information system, a marvel of organizational efficiency, was named for him. Across the campus each day those coming online in search of information and knowledge call up ROGER. At the UCSD Faculty Club a center table is designated as Roger's Table. Academicians sit there to exchange ideas with "anybody from any part of the university" in the tradition Roger had so enjoyed at Harvard. A Scripps research vessel, launched in 1995, bears his name. It is the largest ship in the fleet. Ellen christened it with their great college friend, Rollin Eckis, standing close by as her husband of two years. On the sea floor of the western Indian Ocean, north of Madagascar, a mile-high plateau, nearly as large as New England, has been named Revelle Rise. "This isn't just another seamount," his old colleague Bob Fisher says with some belligerence. "This is a big, big thing. Like Roger."