




*Legacy of*  
EXPLORATION

**Scripps Institution of Oceanography since 1903**

DEDICATED TO ALL WHO HAVE SERVED SCRIPPS INSTITUTION OF OCEANOGRAPHY OVER THE YEARS



# *Legacy of* EXPLORATION

Scripps Institution of Oceanography since 1903

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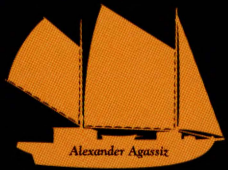
SCRIPPS INSTITUTION OF OCEANOGRAPHY  
University of California, San Diego

The original Scripps campus, as viewed from La Jolla,  
circa 1910. The George H. Scripps Memorial Marine  
Biological Laboratory is now a National Historic Landmark.

SCRIPPS INSTITUTION OF OCEANOGRAPHY, 1927







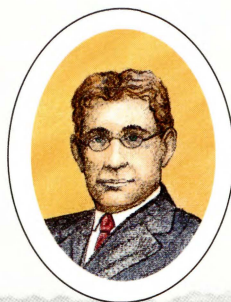
## COASTAL ORIGINS: 1903-1936

In 1892, University of California zoology professor William E. Ritter, his colleagues, and students began field studies along the California coast. To this pioneering scientific group, the need for a permanent marine station soon became clear. When invited to conduct its 1903 summer session in San Diego, the group's need was also recognized by influential members of that community. Ritter returned the following summer, and civic leaders interested in his work joined him in organizing the Marine Biological Association of San Diego. Its goal was to establish a local marine laboratory, appointing Ritter its scientific director.

Transferred to the University of California in 1912, the marine laboratory became Scripps Institution for Biological Research, in honor of ardent supporters and principal benefactors E.W. Scripps and his sister Ellen Browning Scripps. In 1924, geologist Thomas Wayland Vaughan became the institution's second director. The following year, its name was changed to Scripps Institution of Oceanography (SIO), in recognition of the widened range of studies conducted by a growing faculty. Under Vaughan, graduate studies were expanded, and, as America's first oceanographic institution, Scripps offered studies leading to a Ph.D. degree in the science of oceanography.

## LEADERSHIP

William E. Ritter



William Ritter received a Ph.D. in zoology from Harvard in 1893. A decade later, he helped to found a marine laboratory in San Diego, where his dedication, sense of purpose, and leadership inspired support for the establishment of Scripps Institution of Oceanography. Professing a balanced view of nature, Ritter combined biology, physical science, and mathematics with philosophy. He believed in the need for a team of specialists working together to understand organisms in the context of their physical environment. He was inspired by "the vast scale on which things are done in the ocean, and the literally infinite complexity of cause and law there in operation."

The Hotel del Coronado boathouse (below), where William Ritter and his colleagues (right) conducted their 1903-04 summer sessions.

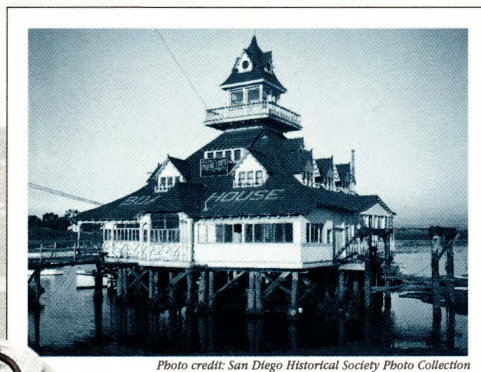
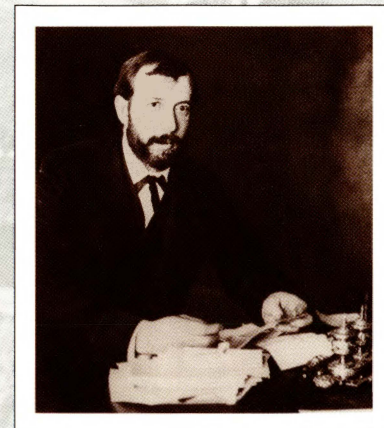


Photo credit: San Diego Historical Society Photo Collection

Publisher E.W. Scripps, years before moving to San Diego where his friendship with Ritter began.



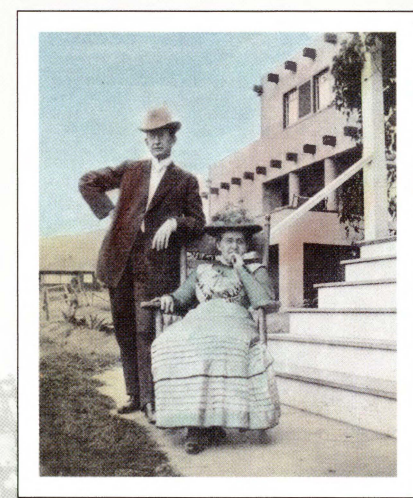
The basketweave cusk-eel. First described in 1916 as *Otophidium scrippsi* and named in honor of Ellen Browning Scripps by biologist Carl L. Hubbs. Drawing by W.S. Atkinson from the UC publication *Notes on the Marine Fishes of California*.



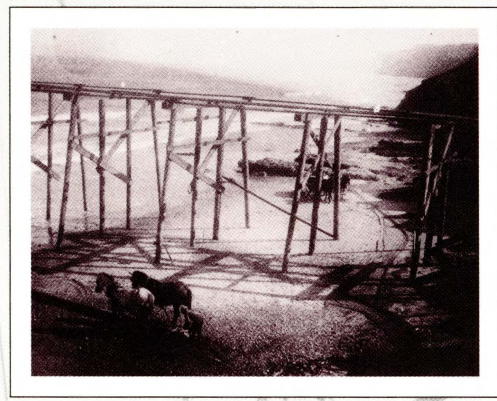
Ellen Browning Scripps at home (below); as featured in a 1926 *Time* magazine (left).



Virginia Scripps, the family naturalist, during an excursion in the mountains of Japan.



Ritter and his wife, physician Mary Bennet, at the La Jolla residence of Ellen Browning Scripps in 1908.



The first pier under construction in 1915.



The *Alexander Agassiz* was the institution's first research vessel.

Scripps Institution for Biological Research. The George H. Scripps Laboratory (left of water tower), completed in 1910, still stands. The building in foreground, built as the director's residence, is also still in use.



Background photo: the research vessel *Alexander Agassiz*, anchored in San Diego harbor.

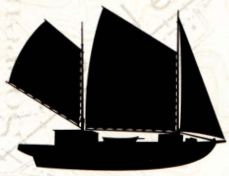
# MISSION

## Pioneering surveys of the California coast

As stipulated in the bylaws of the Marine Biological Association of San Diego, the new institution's mission was to perform "a biological and hydrographic survey of the waters of the Pacific Ocean adjacent to the coast of Southern California." From 1908, physicist George McEwen was gathering data on ocean temperatures, tides, and currents. He eventually began to make long-term weather forecasts based upon records of sea-surface temperatures.

During the 1920s, the institution's activities expanded to include marine geology as well as chemical and biological oceanography. As pointed out by director T. Wayland Vaughan, Scripps was the only institution on the West Coast engaged in a comprehensive program of oceanographic research.





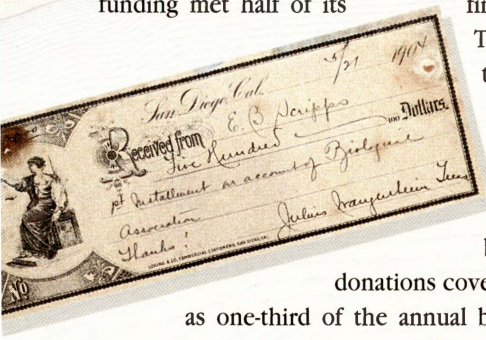
## SUPPORT FROM PHILANTHROPY, STATE FUNDING, AND APPLIED RESEARCH

Following establishment of the marine laboratory, Marine Biological Association members Homer Peters, E.W. Scripps, and Ellen Browning Scripps pledged \$500 each in annual support. The association paid \$1,000 for a 170-acre parcel north of La Jolla, where the Scripps campus was built. Ellen provided funding for the acreage, for the first buildings and pier, and for an access road. She also paid for one of the first Scripps research vessels. E.W. contributed more than \$40,000 and loaned his yacht for research excursions.

In 1912, the marine laboratory became part of the University of California, and by 1925, state funding met half of its financial needs.

Throughout this period, substantial support continued to be provided by Ellen, her

donations covering as much as one-third of the annual budget. Major funding also came through applied research programs for the U.S. Bureau of Soils, the Navy, San Diego Gas & Electric, and the Kelco company. In 1930, a new laboratory was built with \$40,000 each from the state, from Ellen, and from the Rockefeller Foundation, the institution's first foundation grant. In 1932, Ellen Browning Scripps established an endowment of \$400,000 that continues to provide support for Scripps Institution of Oceanography.

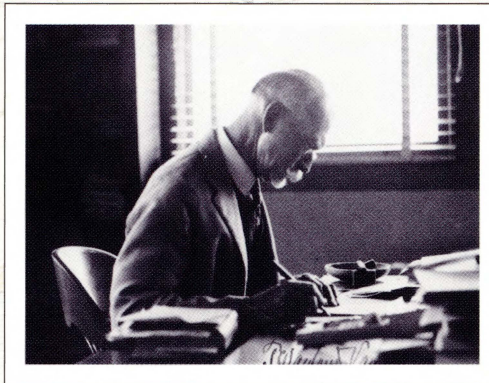


## VISIONS

### Understanding “the relation of organisms to their environment”

Ritter conducted his studies using an approach new at the time. Marine organisms were observed not just as taxonomic specimens—the traditional method—but in the context of their habitats. The object was to understand, in Ritter's words, “the relation of organisms to their environment.”

To this pioneering ecological research, Vaughan added studies of the seafloor. His was an interdisciplinary approach that balanced physical, chemical, biological, and geological studies. With this expanded curriculum, and a desire to internationalize research efforts, Vaughan guided the institution on its course toward recognition as a world center for oceanographic study.



Thomas Wayland Vaughan in the director's office (far left), and with staff and faculty in front of the original library in 1929.

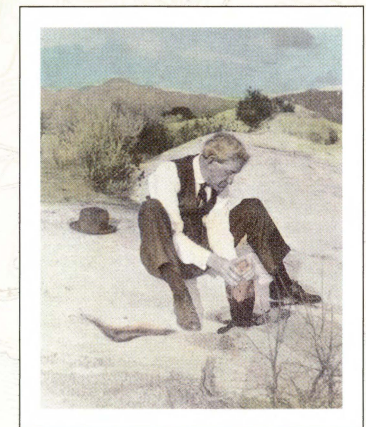
## LEADERSHIP

### Thomas Wayland Vaughan



T. Wayland Vaughan received a Ph.D. in geology from Harvard in 1903. An eminent specialist in seafloor geology and coral reefs, he left the U.S. Geological Survey to become director of Scripps in 1924.

Vaughan broadened the institution's research objectives and its educational purpose, and sought international recognition for Scripps. Appointed chairman of the International Committee on the Oceanography of the Pacific in 1926, his leadership was clear in a statement of committee goals: “Each country should develop a program of research, laying special stress on that part of the Pacific Ocean adjacent to and readily accessible from its shores.”



The ever-curious Ritter tries grinding acorns at Warner Hot Springs, California.



## THE INSTITUTION'S FIRST BENEFACTORS

In 1903, renowned newspaper publisher E.W. Scripps and his sisters Virginia and Ellen Browning Scripps were introduced to Professor Ritter by a mutual friend, Dr. Fred Baker of San Diego. Ritter's studies fascinated the Scrippses. Ellen and her sister Virginia, an amateur naturalist, were keenly interested in science. As his friendship with Ritter grew, E.W. also learned to appreciate the value of applied scientific discoveries and the potential of research to contribute to humanity. During visits to Ritter's temporary marine laboratory, the Scrippses came to appreciate the work being done there and the need for a permanent facility. Joining other prominent San Diegans, they helped to found the institution named in their honor, establishing a tradition of private support that continues to this day.

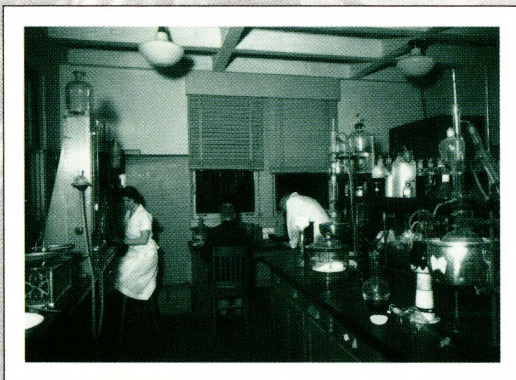


Winfred E. Allen's logbook contains essential historical data on local sea conditions.

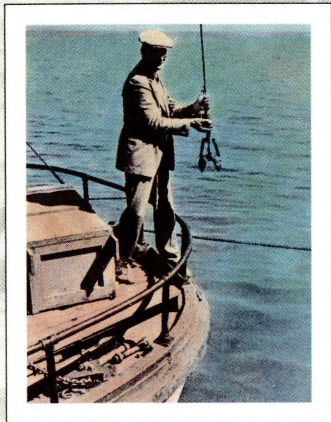
A "bucket-thermometer" holds seawater while the temperature is read.



The chemistry laboratory in Ritter Hall, 1933. (left to right) Kittie Gehring, Eugene LaFond, Richard H. Fleming.

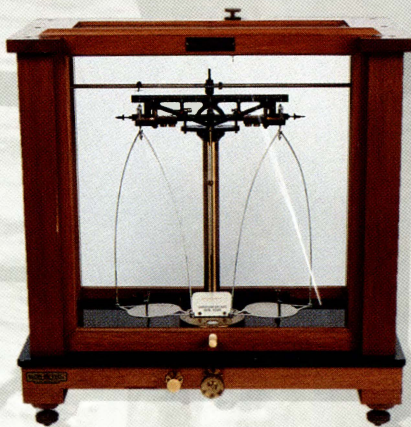


George F. McEwen, the institution's first physicist, joined Scripps in 1908. In this 1930 photograph, he uses a "snapper" to sample seafloor sediments.

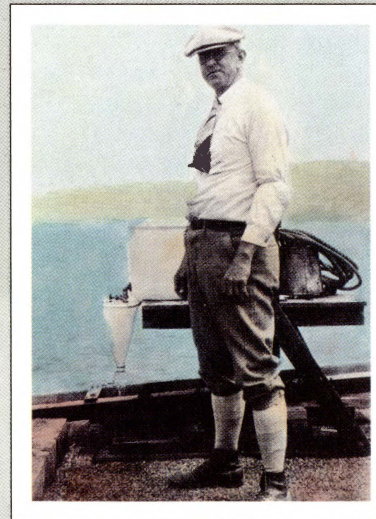


Background photo: aboard the research vessel *E.W. Scripps* in 1935, Richard H. Fleming hands a Nansen bottle filled with seawater to Martin W. Johnson.

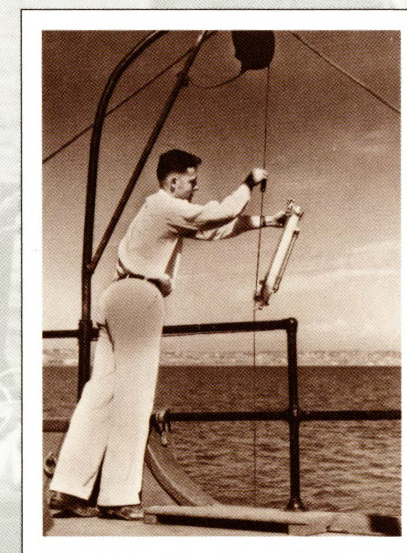
Balance scales used for weighing specimens by Francis B. Sumner, whose zoological studies spanned 30 years at Scripps.



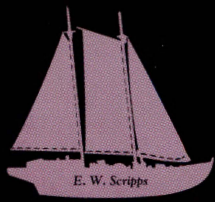
In the early years, staff families lived on campus. This photograph from the 1920s shows two of W.E. Allen's daughters (second and fifth from left).



Winfred E. Allen, sampling water on the pier, studied microscopic marine plants from 1919 until after retiring from Scripps in 1946.



Roger Revelle—deploying a Nansen bottle—entered Scripps as a graduate student in 1931.



## ACTIVE DUTY: 1936-1950

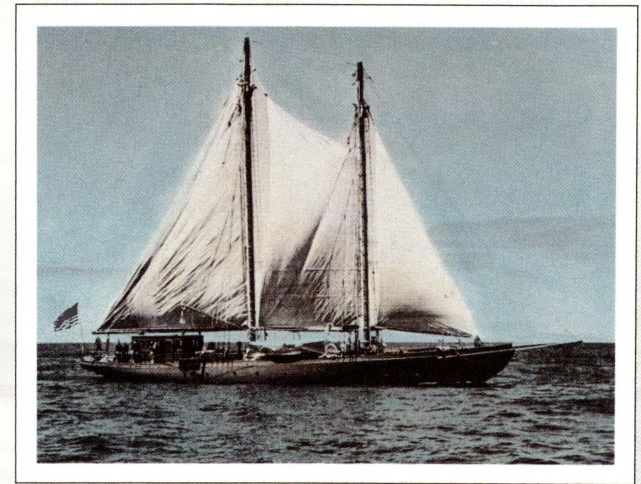
*At the recommendation of T. Wayland Vaughan, Norwegian oceanographer Harald Sverdrup was appointed director of Scripps in 1936. During this period, Scripps achieved international renown, and Pacific oceanography became a focus of the oceanographic community. Benefiting from Sverdrup's extraordinary background and broad expertise, the institution began expeditionary work at sea. In 1939, as Scripps scientists conducted their first research cruise to the Gulf of California, Sverdrup set the stage for future Scripps expeditions: "We are only crossing the threshold to the ocean world."*

*With government and state agencies, a long-term study was launched of California fisheries. In 1937, geologist Francis P. Shepard began surveys of submarine canyons adjacent to Scripps, which continued for more than 40 years. When the United States entered World War II, the University of California Division of War Research (UCDWR) was established on Pt. Loma. During and after the war, Scripps lent its expertise to tackling critical tactical and scientific problems for the military. Among the UCDWR's experts was physicist Carl Eckart, Sverdrup's successor. As director of Scripps from 1948 to 1950, Eckart presided over the institution's dramatic postwar expansion in research programs and facilities.*

## LEADERSHIP

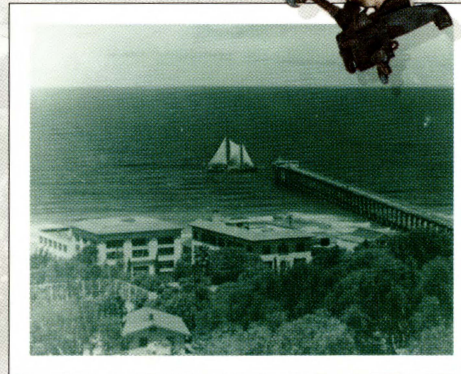
### Harald Ulrik Sverdrup

When appointed director of Scripps in 1936, Norwegian-born Harald Sverdrup was among the world's most distinguished oceanographers. His work encompassed atmospheric physics, meteorology, marine chemistry, tides, oceanographic instruments, magnetics, and ethnology. Sverdrup improved upon the Scripps graduate program, expanded the faculty, and encouraged research at sea. His leadership during World War II contributed to the success of the institution's research programs for the military. In 1948, Harald Sverdrup left Scripps to continue his outstanding career, becoming director of the Norwegian Polar Institute.



The research vessel *E.W. Scripps*—at sea (above); approaching Scripps pier (left).

One of the most widely used oceanographic instruments, the Nansen bottle takes a sample of water at a predetermined depth.



Scripps campus in the prewar calm of 1940.



# EXPANDING INFLUENCE IN PHYSICAL OCEANOGRAPHY AND MARINE BIOLOGY

Among a handful of Ph.D. candidates at Scripps during the late 1930s was physical oceanographer Walter Munk, who came to Scripps in 1939 to study under Harald Sverdrup. Sverdrup and Munk contributed to a defense project conducted by the UCDWR after the outbreak of World War II. They developed a method of forecasting surf conditions using a formula based on data gathered from wind and wave measurements. From 1943, Allied amphibious landing operations owed their success in part to these efforts.

Carl L. Hubbs, a professor of biology at the University of Michigan, accepted a position at Scripps as professor of zoology in 1944. A leading ichthyologist, he organized and expanded the institution's collection of fishes, which now contains more than 2.5 million specimens. He also began observing the annual migration of California gray whales, then on the brink of extinction. Years later, his efforts helped persuade the Mexican government to establish a refuge at Scammon's Lagoon in Baja California, a principal calving ground for the now-thriving gray whale.

Begun in 1947 as the Marine Research Committee, the California Cooperative Oceanic Fisheries Investigations were originally undertaken by Scripps and other agencies to solve the mystery of the disappearing sardine. The program continues to collect data on the physical oceanography and marine biology of the California Current.

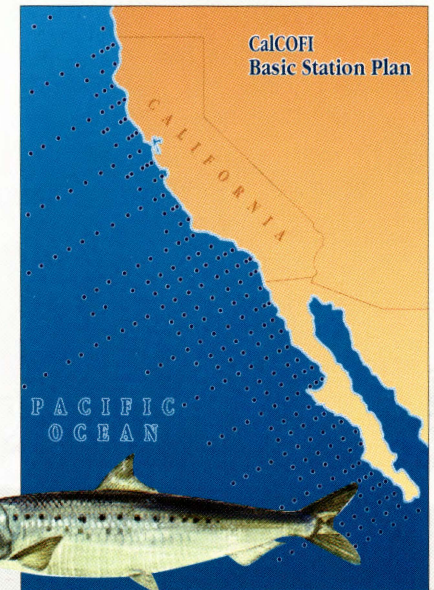
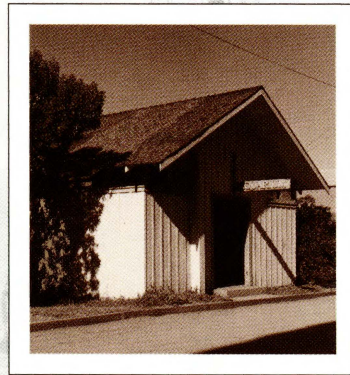


Entrance to the first Scripps aquarium building (below). Opened in 1915, the popular exhibit hall (left) gave way in 1950 to a much larger aquarium-museum.

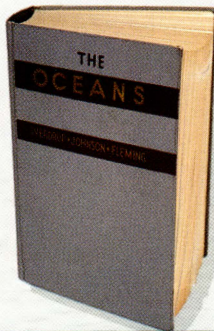
Background photo: the *E.W. Scripps* at anchor off Scripps pier.



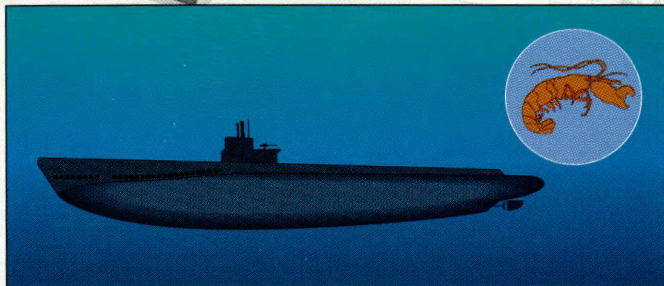
Scripps and UCDWR staff, family, and friends joined by off-duty servicemen for a dance party.



Watercolor painting of the Pacific sardine (*Sardinops sagax*) by George Mattson, scientific illustrator for the Bureau of Commercial Fisheries, now the National Marine Fisheries Service.

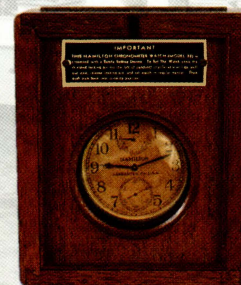


*The Oceans: Their Physics, Chemistry and General Biology* by Harald Sverdrup, Martin Johnson, and Richard Fleming. Published in 1942, it remained the definitive textbook of oceanography for many years.



Experimenting with underwater acoustics, scientists picked up background noise that interfered with submarine detection. Scripps researcher Martin W. Johnson attributed the noise to a widespread species of shrimp. It was thought that when patrolling in waters inhabited by the "snapping" shrimp, U.S. subs could use its noise as a sound camouflage.

A navigator's chronometer, used for precise time-keeping at sea.



Walter Munk with mentor Harald Sverdrup (right), was a graduate student at Scripps in 1940.



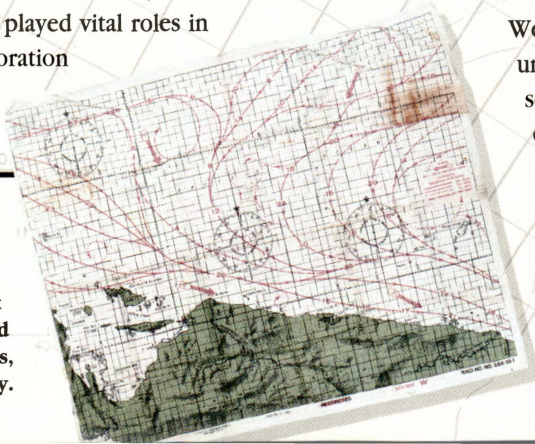
## FEDERAL, STATE, AND INDIVIDUAL SUPPORT

In 1946, the Navy established the Office of Naval Research (ONR) to follow up on important developments that had arisen from wartime research projects. The same year, Scripps signed a contract with the ONR to conduct research, and the institution was paid \$120,000 for its first 12 months of work. An ONR report on this period stipulated that Scripps "conduct surveys and research, analyze and compile data and technical information, prepare material for charts, manuals, and reports, and foster the training of military and civilian personnel."

In 1947, the state allocated \$300,000 (later increased) to the University of California to fund the first year of a three-year study conducted by Scripps. The objective was to solve the mystery of the disappearing Pacific sardine, source of the state's most important fishery. These and other UC appropriations continued, as did annual income from the Scripps family endowment, and donations from the Ellen Browning Scripps Foundation.

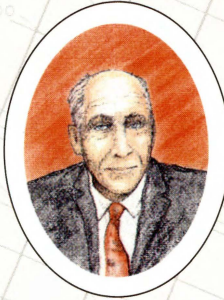
By 1948, the Navy had provided Scripps with two ships for its research fleet, along with funding for a third. Refitted and renamed, the *Horizon*, *Crest*, and *Paolina-T* played vital roles in the institution's exploration of the Pacific.

Flyer's scarf printed with navigational chart. If downed at sea, it was thought that a pilot might use this to find favorable currents, drifting to safety.



## LEADERSHIP

Carl Eckart



An eminent theoretical physicist at the University of Chicago, Carl Eckart's association with Scripps began in 1942 when he joined the University of California Division of War Research. There, his expertise was crucial to progress made by Scripps researchers in development of sonar systems for the military. From 1948 to 1950, he served as director of both the institution and its Marine Physical Laboratory (MPL), formed out of the UCDWR following World War II. After his tenure as director of Scripps, Eckart's continued leadership within MPL assured its status as a pioneering laboratory in ocean acoustics research.

Background photo: wartime research on wave refraction produced maps such as this of the La Jolla coastline.



University of California Division of War Research (UCDWR) personnel (above) were issued special security IDs. The Scripps vessel *Stranger* (left) performed wartime scientific missions for the military. Harald Sverdrup (below) returned to his native Norway in 1948 to head the Norwegian Polar Institute.



## VISIONS

### International oceanography

West Coast oceanography at last gained international recognition under Sverdrup. During their first large-scale expedition, Scripps scientists surveyed the currents, chemistry, geology, and biology of Mexico's Gulf of California. In conjunction with federal and state agencies, Sverdrup enlisted the institution in a long-term, cooperative study of the fisheries resources of the California Current, a program that is still under way.



Photo credit: Robert Marc Friedman

# MISSION

## An oceanographic task force

Following the outbreak of World War II, Scripps researchers made invaluable contributions to the war effort. Working with UCDWR scientists, they helped develop sonar, echo-sounding, and bottom-scanning technologies for antisubmarine warfare. Harald Sverdrup and others supervised meteorological training of pilots and naval personnel. Forecasts by researchers of coastal sea conditions assisted successful amphibious landing operations. These efforts helped establish a critical role for applied oceanographic research in matters of national security.



## Operation Crossroads—1946

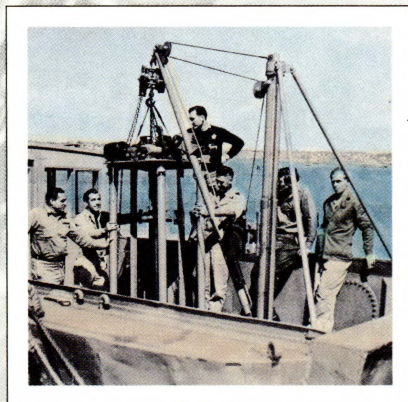
The oceanographic mission of Operation Crossroads was to determine the environmental impact of the atomic detonation on Bikini Atoll in the South Pacific. “The most complicated laboratory experiment ever undertaken,” according to chief oceanographic officer Roger Revelle, the object was “to carry out an integrated investigation of all aspects of the natural environment within and around the atoll.”



Sonar (sound navigation and ranging) was developed for anti-submarine warfare. Passive sonar used microphones to pick up submarine engine noise, which could be transmitted from the surface to patrolling aircraft. Active sonar used ultrasonic pulses which bounced off their target to produce a distinctive echo.

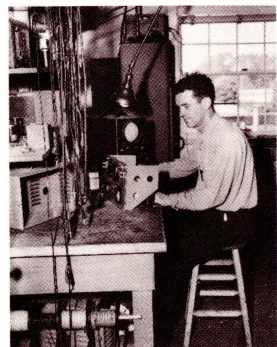
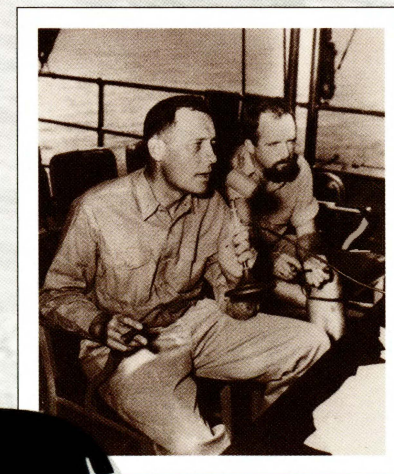


The ability to predict surf conditions in landing zones was essential to minimize casualties and equipment losses.



Harald Sverdrup (center) trained Army and Navy meteorologists in forecasting sea-surface conditions.

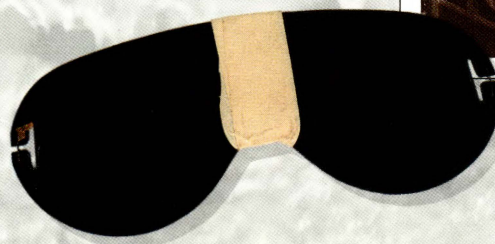
Roger Revelle (left) and Jeff Holter at Bikini Atoll during Operation Crossroads. At lower left, goggles worn by Revelle during atomic tests.



UCDWR personnel worked in laboratories and at sea, contributing much to wartime research.

Background photo:  
U.S. Marines wade ashore at Tinian, in the South Pacific.

Photo credit: MCRD Command Museum Archives





## PACIFIC HORIZONS: 1950-1965

*Scripps faculty member Roger Revelle became director in 1950. The appointment was strongly recommended by Harald Sverdrup, who looked to Revelle to transform Scripps into a seagoing institution. During this period, Scripps research ships sailed throughout the Pacific, making significant contributions to new developments in marine geology, chemistry, and global climate studies. He recruited chemist Charles D. Keeling to begin monitoring carbon dioxide in the atmosphere, a long-term program that supports current understanding of global warming. During the early 1960s, Revelle was appointed to government and university posts in Washington, D.C., at Harvard, and at the newly established campus of the University of California, San Diego (UCSD).*

*Taking over administrative duties in 1961, Fred N. Spiess became director of Scripps in 1964. Physicist, marine engineer, and administrator, he served as director until 1965. Spiess had already contributed much to marine engineering developments at the institution's Marine Physical Laboratory (MPL), formed at the end of World War II out of the UCDWR. Director of MPL from 1958 to 1980, he served in that post throughout his tenure as SIO's director, and long afterward. He also helped establish the Physiological Research Laboratory (PRL), expanding programs in biology and chemistry at Scripps.*

## LEADERSHIP

### Roger R. Revelle

Entering Scripps in 1931 as a graduate student, Revelle received his Ph.D. in oceanography in 1936. Joining the Scripps faculty, he taught marine geology and participated in the institution's first long-range research cruise.

Called to active duty with the Navy in 1941, Revelle participated in plans to establish the Office of Naval Research (ONR) following the war. He served as director of Scripps from 1950 to 1961, personally leading expeditions into the deep-water regions of the Pacific. Scientist and humanitarian, Revelle's achievements were remarkably diverse. He was selected by President Kennedy to oversee development projects in Pakistan, was professor of population studies at Harvard, and was instrumental in founding the University of California, San Diego. He was professor of science and public policy at UCSD, where Revelle College bears his name.



Exhibits in the T. Wayland Vaughan Aquarium-Museum, opened in 1950.



An early sound-spectrum analyzer, used in underwater acoustics research.



During the 1952 CAPRICORN expedition, Scripps researchers made their first scientific dives using scuba equipment.



During the 1950s, the Scripps research fleet included (left to right) the *Horizon*, *Paolina-T*, and *Crest*.



# MISSION

## To use the Earth wisely

Revelle acquired the ships, funding, and personnel needed by Scripps to conduct comprehensive surveys in the deep waters of the Pacific. Under Revelle's direction, Scripps embarked upon the California Cooperative Oceanic Fisheries Investigations (CalCOFI), proceeding with an environmental approach to fisheries biology. Revelle believed that "knowledge of the air and the sea and the solid earth, and of our fellow creatures who share this planet, increases our ability to use the earth wisely and well."



(clockwise from above) Scripps campus during the 1950s. Gustav Arrhenius and Roger Revelle during the CAPRICORN expedition. A Scripps field station during tests in the South Pacific.



Photo album from the 1950 MIDPAC expedition, compiled by Edward S. Barr.



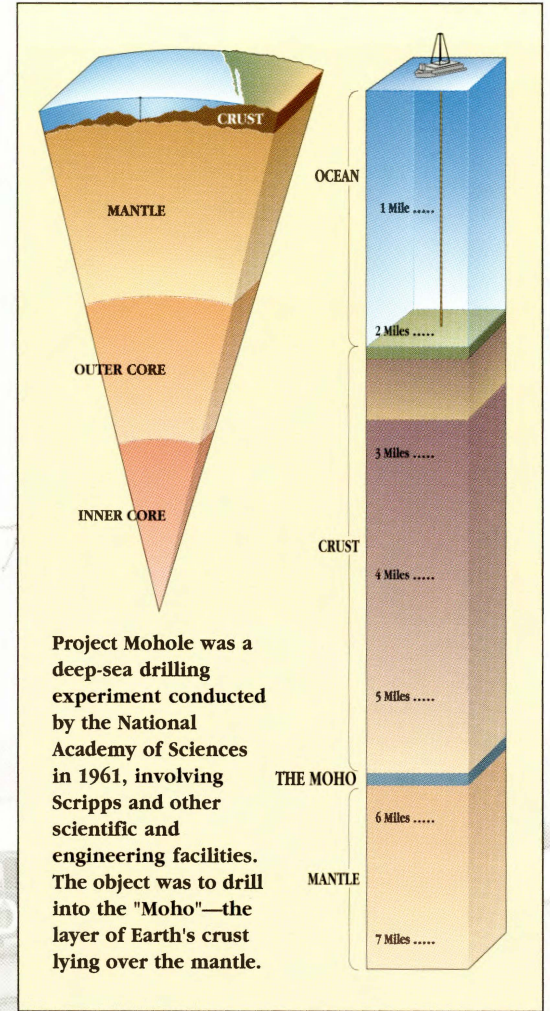
Horizon's on-board chemistry laboratory, circa 1950 (left). Special cases were designed to prevent breakage of bottled seawater samples during cruises.



Background photo: the Scripps research vessel *Horizon*.



A bathythermograph is used to measure temperature at various depths.



Project Mohole was a deep-sea drilling experiment conducted by the National Academy of Sciences in 1961, involving Scripps and other scientific and engineering facilities. The object was to drill into the "Moho"—the layer of Earth's crust lying over the mantle.



## SUPPORT FOR ONE OF THE WORLD'S LARGEST OCEANOGRAPHIC INSTITUTIONS

During this period, Scripps became one of the largest oceanographic institutions in the world. Between 1950 and 1952, the Scripps research fleet completed the MIDPAC, NORTHERN HOLIDAY, SHELLBACK, and CAPRICORN expeditions. They were, according to Revelle, "voyages of discovery in which new instruments for oceanographic exploration were pitted against the vast unknown of the Pacific Ocean." Government-funded exploration of the seafloor accounted for a significant part of these research missions.

In 1965, annual support for Scripps reached \$10 million. Government agencies, led by the Office of Naval Research and including the National Science Foundation and the Atomic Energy Commission, accounted for the largest portion of this funding. State appropriations through the University of California also continued to be significant. The institution's campus featured greatly expanded classroom and laboratory facilities, and one of the best oceanographic libraries in the world. The research fleet, then eight vessels strong, was larger than ever before.

Background photo: navigational chart of the northeastern Pacific used during Scripps expeditions, 1950–1965.

Early model of FLIP, improvised from a Louisville Slugger baseball bat.



## LEADERSHIP

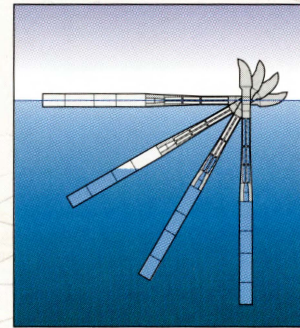
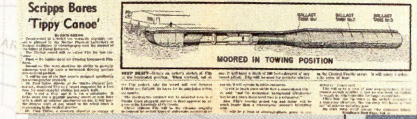
### Fred Noel Spiess

UC Berkeley physicist Fred Spiess served first as acting director and then director of SIO from 1961 to 1965. A submarine officer during World War II, Spiess applied his exemplary leadership skills at Scripps, earning the highest regard as an administrator. A gifted innovator, his engineering talents contributed to development of new technologies for ocean exploration. These included the world-famous Scripps research platform *FLIP* and *Deep Tow*, a prototype remotely operated vehicle.

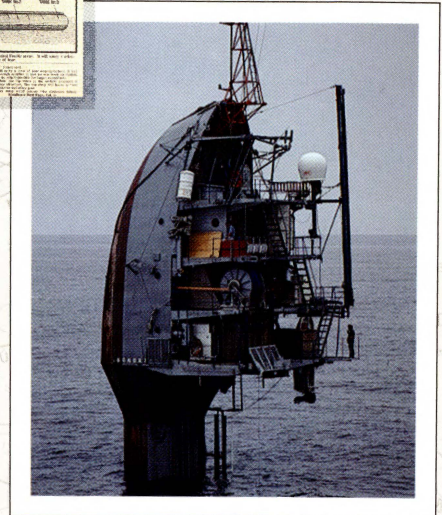


Fred Spiess testing the controls of an experimental floating airfield.

### Weird Craft to Scan Ocean Depth



The Floating Instrument Platform (*FLIP*) joined the Scripps research fleet in 1962. Originally intended to perform a single research mission for the Navy, *FLIP* has been used for more than 30 years. When its ballast tanks are flooded, it "flips" into a stable vertical position. Hydrophones for ocean acoustics research comprise *FLIP*'s submersible instrument array (lower right).



## VISION

"Finding the courage and the vision to face the future"

Revelle enlisted Scripps in scientific programs of international cooperation. He was instrumental in planning the oceanographic program of the International Geophysical Year (IGY), 1957-58. During the IGY, Revelle and Charles D. Keeling began the now-famous program to monitor atmospheric carbon dioxide, an effort crucial to current understanding of global warming. Revelle initiated the International Indian Ocean Expedition, that lasted from 1959 to 1965. The International Deep Sea Drilling Project beginning in 1964 gathered some of the earliest data used to support the theory of plate tectonics.

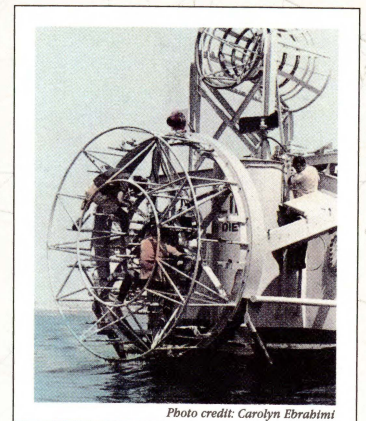


Photo credit: Carolyn Ebrabini

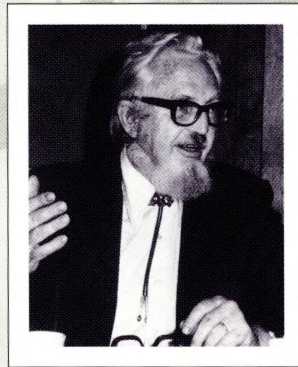
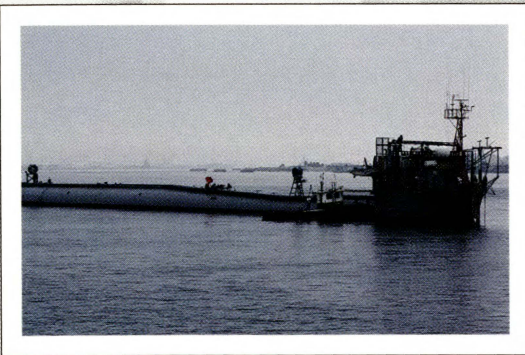


## THE INNOVATIVE GENERALIST AS OCEANOGRAPHER

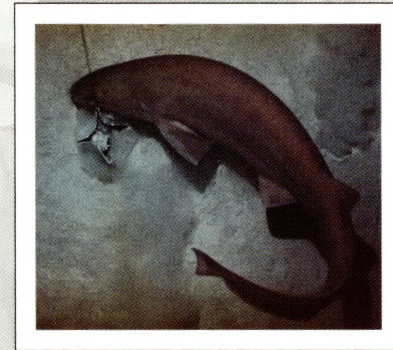
John D. Isaacs launched his seagoing career as a commercial fisherman in the treacherous coastal waters of the Pacific Northwest. During World War II, he and colleague Willard Bascom tested the performance of military amphibious vehicles under heavy surf conditions. Isaacs graduated from UC Berkeley in 1944 with a degree in engineering, and studied wave characteristics with Harald Sverdrup and Walter Munk. In 1948, at Revelle's invitation, John Isaacs joined Scripps as an associate oceanographer. The Marine Life Research (MLR) program had just been established to conduct that aspect of CalCOFI undertaken by Scripps. Isaacs and colleague James Snodgrass operated the Special Developments Division at Scripps, where many marine biological collecting methods were devised and perfected. Named professor of oceanography in 1961, Isaacs was head of MLR from 1958 to 1974, when he became director of SIO's Institute of Marine Resources.



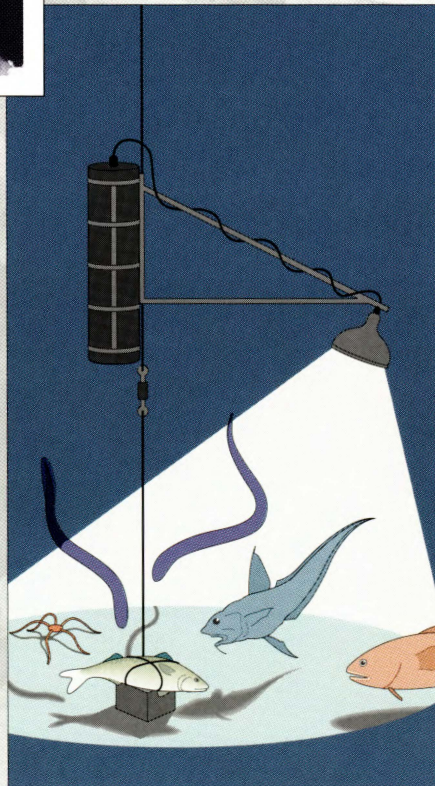
Champagne bottle (above) used to christen *FLIP*. Below, *FLIP* is maneuvered in its horizontal surface position.



John D. Isaacs (left), designer of the deep-water camera (below), used to photograph bottom-dwelling creatures such as sharks and other fishes (right).



Homeward bound—the CAPRICORN expedition, 1952.





## THE NEW OCEANOGRAPHY: SIO SINCE 1965

*In 1965, William A. Nierenberg became director of Scripps Institution of Oceanography, UCSD, and Scripps made great strides, incorporating the latest in computer and satellite technology. In 1966, Nierenberg made this forecast: "The institution and its graduates will be called on more and more to deal with the broad general problems that our society will have to face."*

*Under Edward A. Frieman, director of SIO since 1986, the forecast of his predecessor has proven correct. Research conducted at Scripps is helping us understand our changing world. SIO continues to be the leader in global warming studies. At the Center for Clouds, Chemistry, and Climate (C4), scientists are studying the complex processes that govern climate change. The Institute of Geophysics and Planetary Physics (IGPP) conducts seismic studies in order to better understand earthquakes and their impact. Research begun decades ago at Scripps to monitor fisheries resources in our local waters continues, now conducted by the Marine Life Research Group. MLRG is accumulating an immense and invaluable body of data on coastal ecology. These and other research projects at SIO exemplify the present and the future of the new oceanography, and are helping us prepare for the challenges of the next century.*



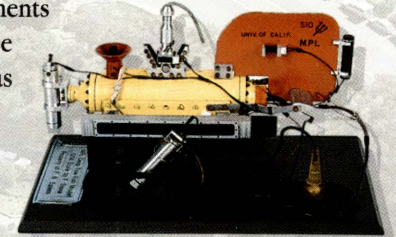
Film footage from *Deep Tow's* cameras was processed aboard ship using this developer can.

## LEADERSHIP

### William A. Nierenberg



William Nierenberg, a professor of physics at UC Berkeley, became director of Scripps in 1965, serving in that post until 1986. During his 22-year administration, SIO's progress was marked by unparalleled growth. His service to local, state, national, and international agencies covers a wide range of fields in science and technology. Nierenberg's career has been distinguished by many accomplishments in atomic and nuclear physics, acknowledged expertise in underwater research and warfare, and several years of service as Assistant Secretary General of NATO for Scientific Affairs.



Precise scale model (above right) of *Deep Tow*, a remotely operated instrument package designed to be towed at depth by surface research vessels. Scientists aboard the *Thomas Washington* (right) used *Deep Tow* to study seafloor geology during the 1970 SEVEN-TOW expedition.



Nansen bottles in the *Argo's* laboratory, during the 1966 ZETES expedition.

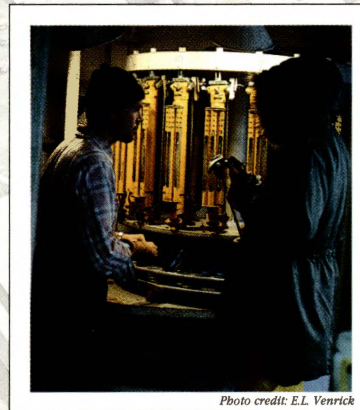


Photo credit: E.L. Venrick

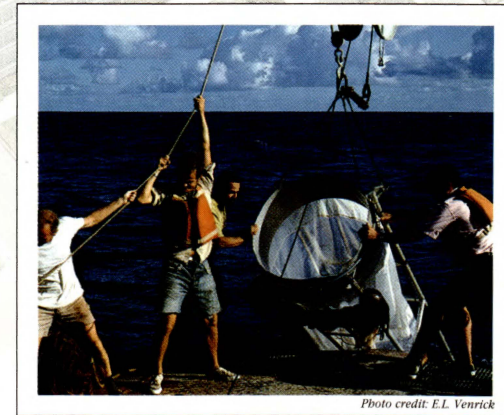


Photo credit: E.L. Venrick

During the 1969 PIQUERO expedition, technicians and researchers deploy a Longhurst-Hardy plankton recorder net—used to collect samples of plankton and larval fish.

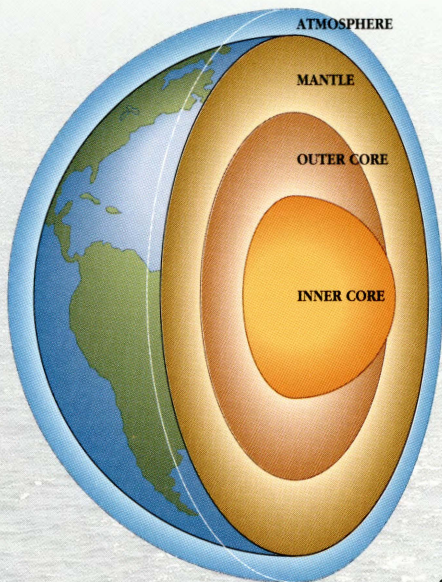
Background photo: the SIO campus today.

# MISSION

## From the Earth's core to the edge of space

Understanding our planet requires a comprehensive knowledge of the oceans, the atmosphere, and the structure of the Earth. More than 300 research programs are now conducted at SIO. These include: coastal studies; climatology; the chemistry, circulation, and ecosystems of the oceans; fisheries resources; plate tectonics; marine geology; and seismology.

At sea, one of the world's most advanced institutional research fleets carries SIO scientists on missions throughout the world's oceans. On land, experiments are conducted, data gathered, and results examined in an array of laboratories. And on the high frontier, airborne and satellite technology are providing researchers with global monitoring capabilities.



The *Melville* is one of the world's most capable oceanographic research vessels.



During the Deep Sea Drilling Project, begun in the early 1960s, this bit was used to drill beneath the ocean floor, revealing much about the structure of the Earth.

Deep-sea hydrothermal vents called "black smokers" gush dense plumes of mineral-rich water, reaching temperatures of more than 570° F. Shell of a rare clam (bottom) collected from the abyssal depths of the Peru-Chile Trench.

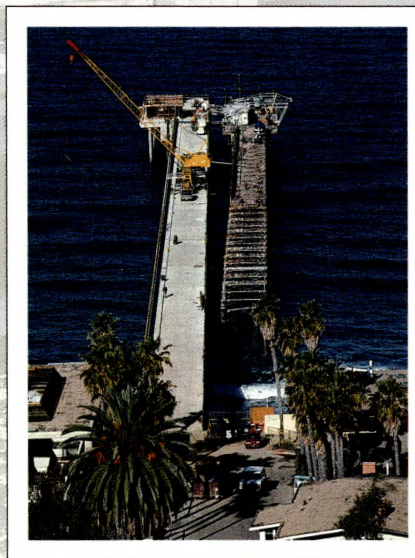


Photo credit: Fred N. Spiess



Photo credit: Gerald Kooyman

SIO research extends to the Antarctic.



The Ellen Browning Scripps Memorial Pier reaches completion in 1988, as the old pier—on its right—is dismantled.

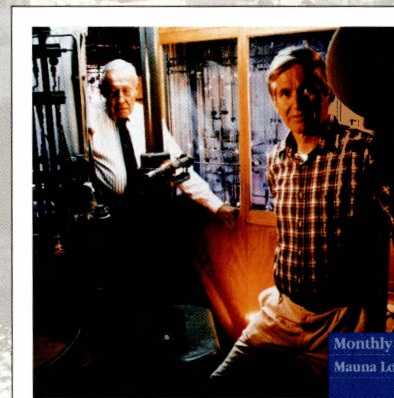
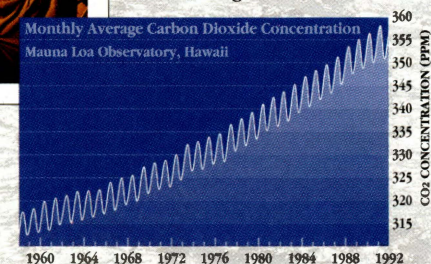


Photo credit: Fredrich Cantor

The program begun by Roger Revelle (left) and Charles D. Keeling to monitor atmospheric CO<sub>2</sub> levels is now the keystone of global warming studies. The data summarized below reveal that CO<sub>2</sub> (measured in parts per million) in the Earth's atmosphere is increasing at an accelerating rate.





## NEW GROWTH THROUGH FEDERAL FUNDING AND PRIVATE SUPPORT

While federal allocations continue to fund many of the institution's current research programs, support from additional sources, both public and private, has grown significantly in recent years. From Ellen Browning Scripps's original gift of \$400,000, the institution's endowment has grown to over \$10 million. The Scripps Institution of Oceanography Associates, a membership group numbering more than 10,000, is an impressive example of the growing degree of public support for the institution.

Facilities have also grown in number and sophistication. The SIO research fleet, based at the Nimitz Marine Facility on Pt. Loma, is considered to be among the world's most modern and capable institutional fleets. One of the newest buildings is the Stephen Birch Aquarium-Museum. Built entirely through private donations, and provided with exhibits accomplished in part through a grant from the National Science Foundation, this facility is a multi-million dollar center for public programs in marine science education.

Corporations, philanthropic organizations, and individuals are now playing an important part in ensuring the continuing vitality of programs at SIO. Endowments and direct donations are helping to make this possible. Looking ahead to our centennial in 2003, we have established the Centennial Endowment to provide support and ensure the flexibility needed in our next century of discovery.

Background photo: satellite image of weather patterns over the north-central Pacific.

Photo credit: National Oceanic and Atmospheric Administration

## LEADERSHIP

Edward A. Frieman

Edward Frieman's leadership as SIO's director since 1986 has been shaped by his many achievements in academia, large-scale energy research programs, and service to the nation. Frieman served with the Navy following World War II as a diving officer, and participated in the atomic bomb tests at Bikini Atoll in the South Pacific. For 25 years he was professor of astrophysical sciences at Princeton University, followed by two years as director of energy research with the U.S. Department of Energy. He was executive vice president of Science Applications, Inc. and an adjunct professor of physics at the University of California, San Diego for five years prior to becoming director of SIO.

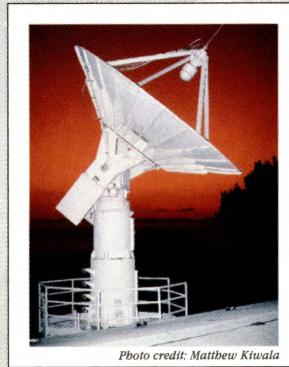


Photo credit: Matthew Kitwala

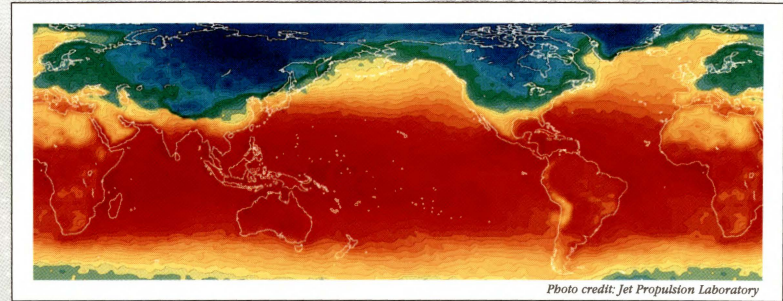
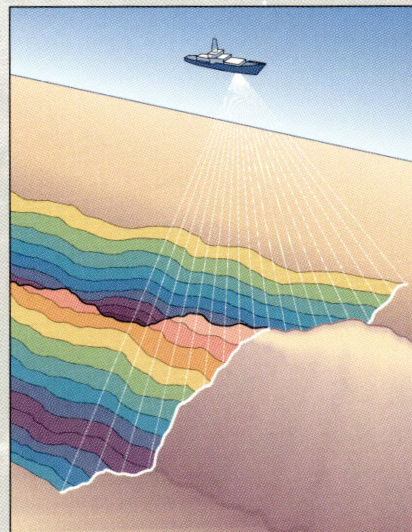


Photo credit: Jet Propulsion Laboratory

Satellite imaging indicates worldwide sea-surface temperatures. Warm equatorial waters are contrasted with much cooler polar regions.

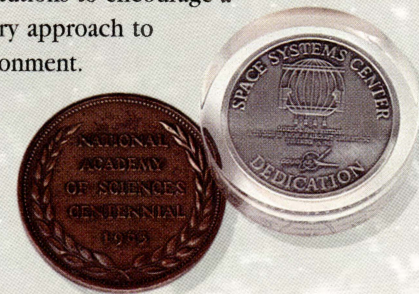


The SeaBeam 2000 is an echosounding system capable of "swath mapping" a strip of seafloor up to 14 miles wide in a matter of seconds. Specially designed for SIO, the system has surveyed hundreds of thousands of square miles of seafloor.

## VISION

### Serving science and society

SIO has become an important center for integrated global environmental research, and a national resource for the converging needs of science and society. In the words of Edward Frieman: "Global scientific problems are increasingly coming to the fore, creating new opportunities for Scripps to help solve major problems facing our planet." In fulfilling this role, Frieman has initiated partnerships with various agencies and institutions to encourage a comprehensive, interdisciplinary approach to understanding the global environment.



# CONTINUING A TRADITION OF RESEARCH, EDUCATION, AND INVOLVEMENT

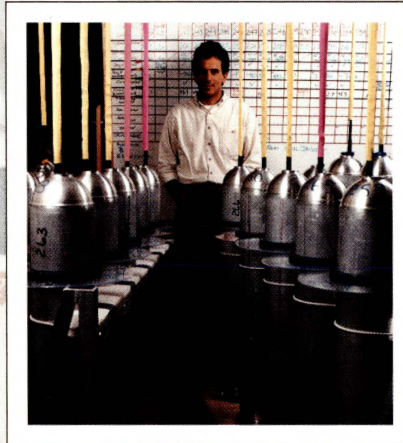
For much of SIO's history, basic research programs have been accompanied by applied research missions, undertaken in the interests of the nation, of industry, and of conservation. Now and in the future, research conducted at the institution promises to benefit society in ever more significant ways.

Equal in importance to SIO's research mission is its role as an educational institution. Ever since its founding, Scripps has both prepared scientists for future careers and has involved graduate students in the institution's basic mission of conducting research. Reflecting the interdisciplinary nature of oceanography, the SIO graduate program offers advanced degrees in a number of fields.

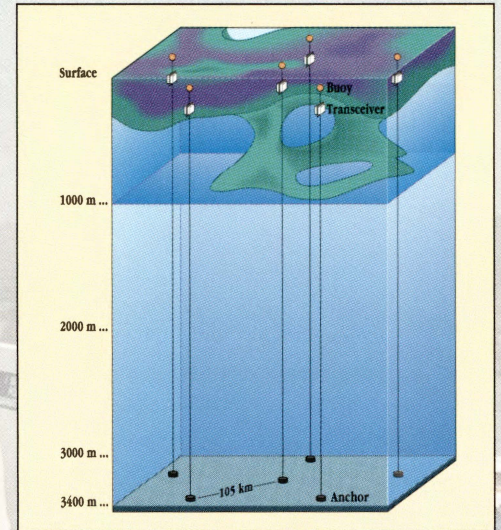
SIO's shore facilities include the Kendall-Frost Mission Bay Marsh Preserve, designated for teaching and research.



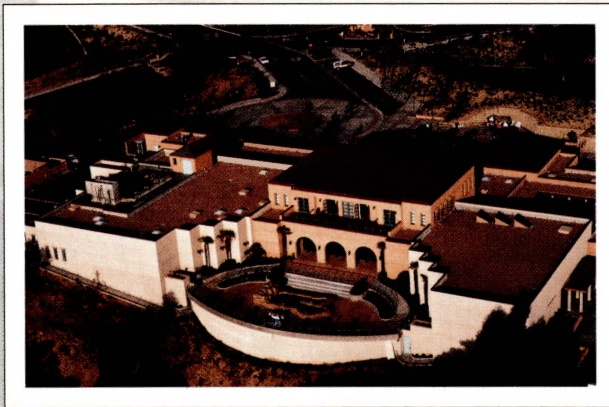
**ALACE (Autonomous Lagrangian Circulation Explorer)** is an automated instrument used to measure deep-ocean currents. Gathering data at various, preprogrammed depths, it surfaces to transmit data via satellite.



The Acoustic Thermometry of Ocean Climate (ATOC) project is being conducted by SIO's Institute of Geophysics and Planetary Physics to measure global ocean temperature. The speed at which sound travels in the ocean is affected by the water's temperature. By measuring the transmission time of underwater signals, acoustic tomography can determine changes in ocean temperatures. The illustration depicts a small scale array of tomographic moorings in the Greenland Sea. The green and purple areas at the top of the water column represent temperatures measured below 29.9° F.



An instrument array is deployed from the *Knorr* of Woods Hole Oceanographic Institution (WHOI) during a joint SIO-WHOI experiment in acoustic tomography, conducted in the Greenland Sea.



The Stephen Birch Aquarium-Museum opened in 1992.

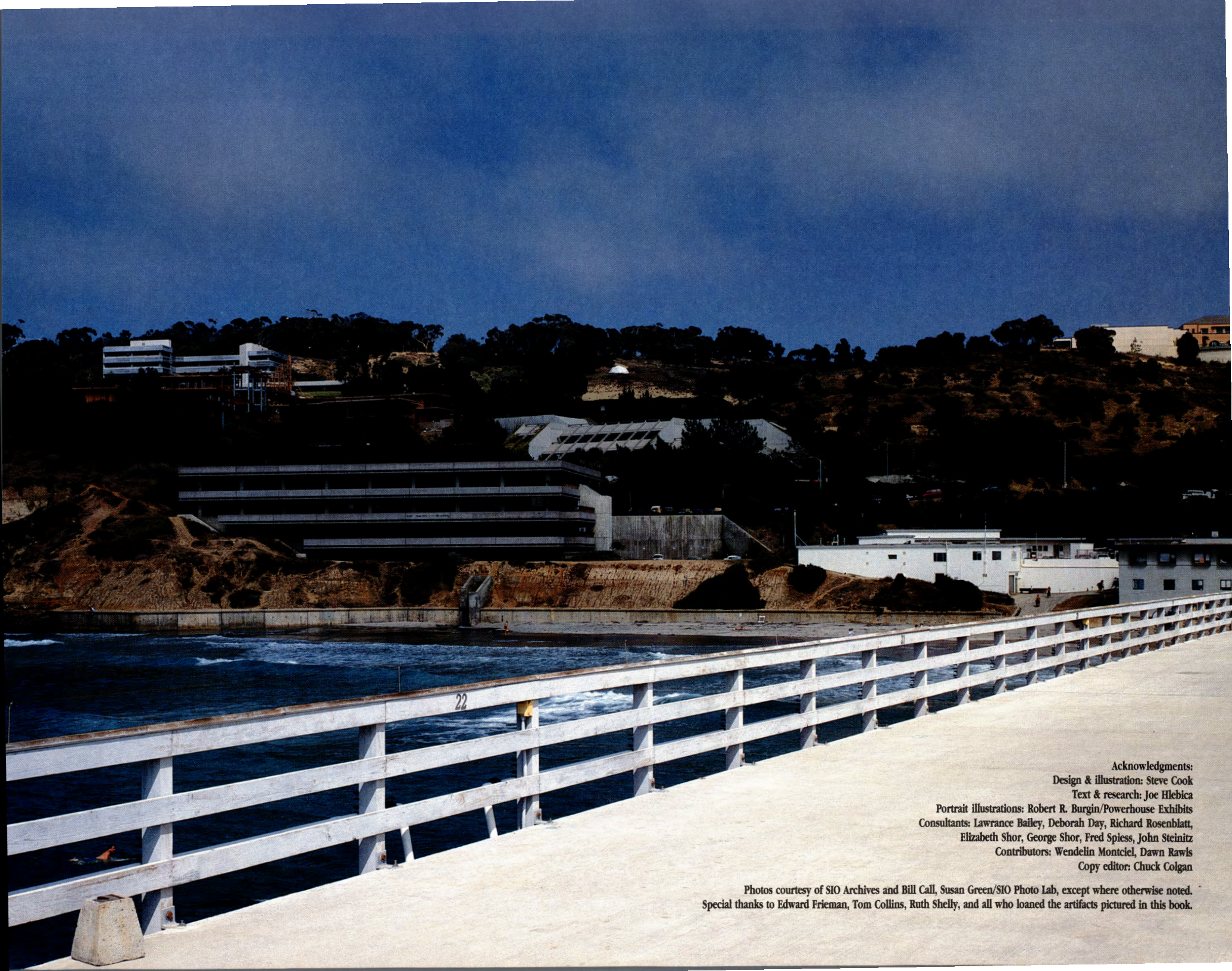
Background photo: Marine Life Research Group (MLRG) scientists deploy instruments and sampling devices near Pt. Loma.



SIO petrologists (left) contribute to current understanding of the Earth's structure. (above) Seawater samples are used by physical oceanographers to conduct a variety of tests.



Photo credit: Peter Worcester



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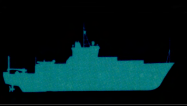
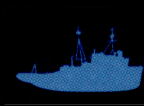
Photos courtesy of SIO Archives and Bill Call, Susan Green/SIO Photo Lab, except where otherwise noted.  
Special thanks to Edward Frieman, Tom Collins, Ruth Shelly, and all who loaned the artifacts pictured in this book.

# SCRIPPS INSTITUTION OF OCEANOGRAPHY, TODAY



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A publication of the Stephen Birch Aquarium-Museum and  
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# STEPHEN BIRCH AQUARIUM-MUSEUM

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