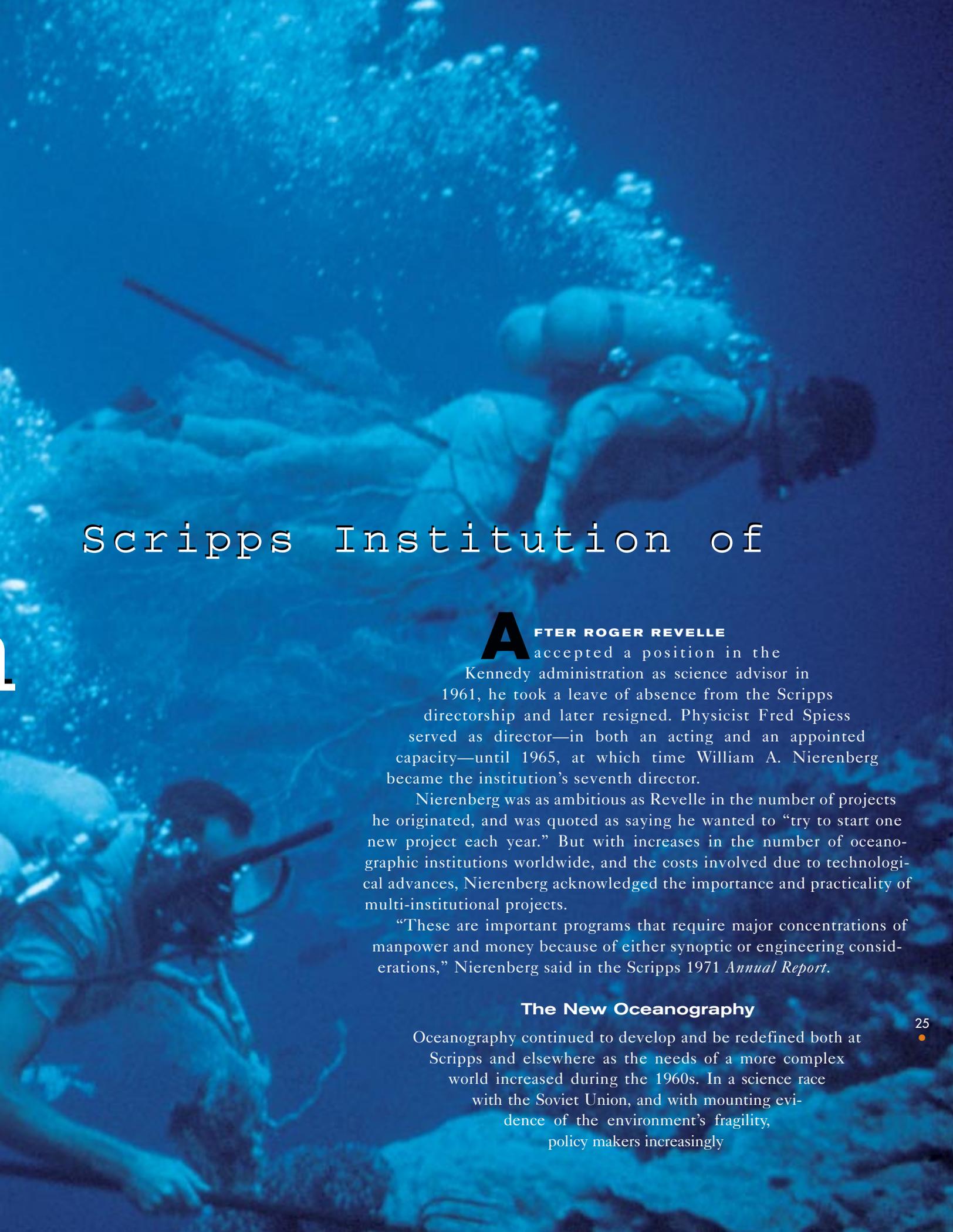




In 2003, Scripps Institution of Oceanography will celebrate its first century of oceanographic exploration, research, and discovery. This feature is the sixth in a series of articles that will present special features about the history of Scripps Institution and the science, people, ideas, and technology that have played major roles in its century of leadership.

T H
New
Oceanography
BY JOE HLEBICA



Scripps Institution of

AFTER ROGER REVELLE accepted a position in the Kennedy administration as science advisor in 1961, he took a leave of absence from the Scripps directorship and later resigned. Physicist Fred Spiess served as director—in both an acting and an appointed capacity—until 1965, at which time William A. Nierenberg became the institution's seventh director.

Nierenberg was as ambitious as Revelle in the number of projects he originated, and was quoted as saying he wanted to “try to start one new project each year.” But with increases in the number of oceanographic institutions worldwide, and the costs involved due to technological advances, Nierenberg acknowledged the importance and practicality of multi-institutional projects.

“These are important programs that require major concentrations of manpower and money because of either synoptic or engineering considerations,” Nierenberg said in the Scripps 1971 *Annual Report*.

The New Oceanography

Oceanography continued to develop and be redefined both at Scripps and elsewhere as the needs of a more complex world increased during the 1960s. In a science race with the Soviet Union, and with mounting evidence of the environment's fragility, policy makers increasingly



turned to scientists to help define and set a course of action. The U.S. government recognized the need to provide more support for science and in turn created the National Science Foundation (NSF), which rose to preeminence in the 1960s.

Anticipating a decline in oceanography funding from the Office of Naval Research (ONR), the NSF increased its support of oceanography. The transition from ONR to NSF monies was underscored by legislation that limited most ONR funding to research with military applications. The NSF soon became the primary source of federal dollars for programs at Scripps.

One reflection of this funding shift at Scripps was the North Pacific Buoy Program, an investigation of the causes of weather that was originally supported in the late 1950s with ONR monies, but which later came under the auspices of the NSF. However, innovative ocean exploration in a new era would take more than money alone—it would also require scientists with vision and determination.

John D. Isaacs, director of the Marine Life Research Program at Scripps, oversaw the North Pacific Buoy Program. He had joined Scripps in 1948, bringing with him from UC Berkeley a group of engineers who formed

the nucleus of the Special Developments Division, where many oceanographic instruments were designed and perfected.

Isaacs observed that unusually warm water off the California coast might presage warming on oceanic and even global scales. This, he theorized, might lead to the sort of drastic climate change now attributed to El Niño events.

“It was obvious something was breaking loose clear around the Pacific,”

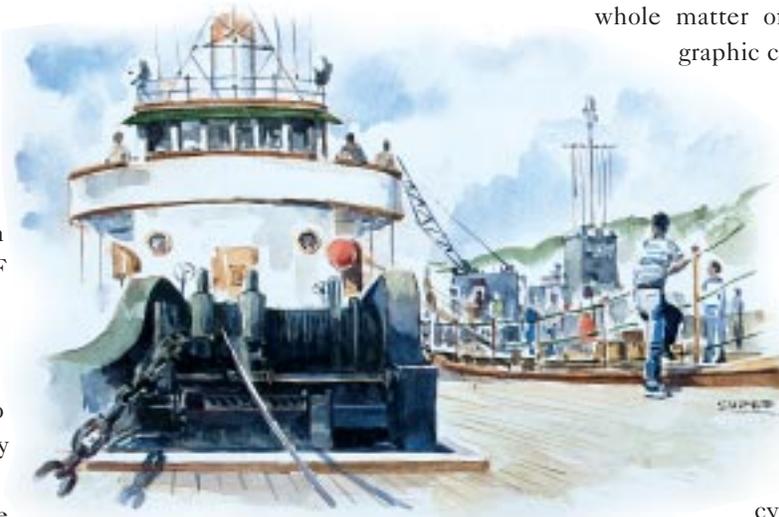
Isaacs reflected. “This gave us a vastly different perspective on the whole matter of climatic and oceanographic change.”

He believed that periodic and dramatic climate changes and geophysical events had had cataclysmic impacts on natural systems throughout geologic history. Earth scientists today accept this as fact.

Isaacs found evidence of cataclysmic cycles in the data gathered

to study the mysterious disappearance

of the sardine along the California coast. Many had assumed overfishing alone was responsible for the crash of this important fishery. Using fossilized remains of sardines and other fishes found in seafloor and shoreline sediments, he demonstrated how fish populations had been booming and busting over millennia. Isaacs concluded that the recent sardine “crash,” though likely assisted by ill-advised fishing practices, was part of a greater natural life-cycle. “I think



John Isaacs and Willard Bascom during their 1966 “sea monster” hunt.

Right (L to R), Perry Crampton, George Hohnhaus, Joe Curray, and Bill Newman during the 1967 Carmarsel Expedition.

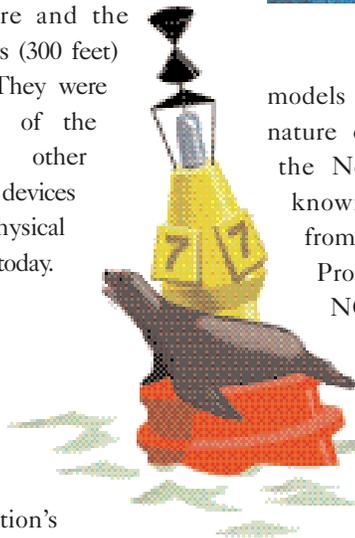
there are many ways in which the ocean gives us an exquisite insight into the past upon which we should certainly be capitalizing,” he said.

In an effort to better understand the changes in the ocean and their effect on weather, Isaacs proposed the first large, moored buoys to be used for continuous remote sensing in the open ocean. Shaped like giant bullets, and painted with easy-to-spot orange and black stripes, the curious “bumblebee buoys” were devised by engineers George Schick and Meredith Sessions. Moored in the deep North Pacific, they measured salinity, wind, and temperatures in the atmosphere and the upper 90 meters (300 feet) of the ocean. They were the precursors of the drifters and other remote-sensing devices used by physical oceanographers today.

SCIENCE AND SCIENCE FICTION COLLIDE

As the institution’s focus on climate research took shape, Scripps recruited Jerome Namias from the U.S. Weather Bureau to develop the Climate Research Group. Using long-term atmospheric data, as well as data from the buoys, he found a correlation between temperature changes across North America and sea-surface temperature changes in the North Pacific.

From these results, and with the development of numerical



models to elucidate the physical nature of these climate changes, the North Pacific Experiment, known as NORPAX, evolved from the North Pacific Buoy Program in the early 1970s. NORPAX signaled another developing trend in oceanography—large multi-institutional, multi-investigator projects coordinated on national and international levels. In addition, expeditions throughout the 1960s united biologists, geologists, and oceanographers of many institutions and nationalities in common research efforts.

The first of these was the Naga Expedition. Setting sail in 1959, Naga was a three-year-long international effort to survey marine resources in the coastal waters of Southeast Asia. Organized by then-director Roger Revelle

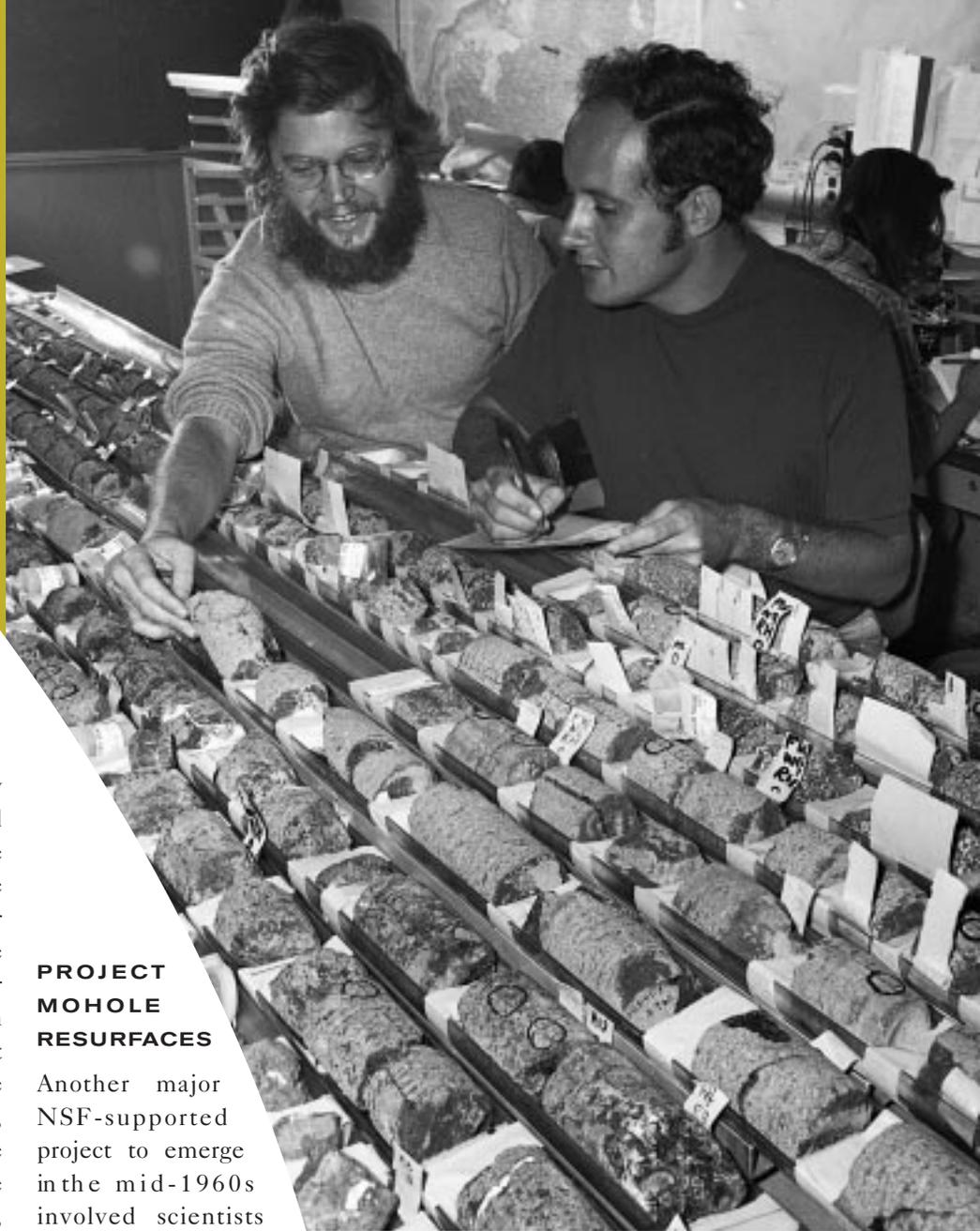


and deployed aboard Scripps’s R/V *Stranger*, Naga’s scientific leader was Danish oceanographer A. F. Bruun. Captain James Faughn was project officer, later succeeded by Frank Miller.

Naga scientists gathered an unprecedented body of data on the physical and biological oceanography of the South China Sea and the Gulf of Thailand. Numerous trawls produced an enormous collection of plankton and fishes from the region.

During the Carmarsel Expedition of 1967, geologists and biologists, including Joseph Curray and William Newman of Scripps, sailed with colleagues from Cornell, Yale, the American Museum of Natural History, and the U.S. Geological Survey. Their goal was to resolve questions about sea-level fluctuations, with the southwest Pacific as their laboratory. The scientists surveyed island

Right, Bill Melson and Fiab Aumento examine core samples during Leg 37 of the Deep Sea Drilling Project. **Below,** Scale model of the Deep Tow instrument vehicle used for collecting geophysical data.



topography, sampled marine terraces, and collected coral and shell samples to determine whether the land had subsided or the sea had risen over the eons.

Driven by a fantastic imagination, Isaacs envisioned a world where science and technology solved problems with what seemed like science-fiction solutions. Some were far-fetched, yet others were effective. The so-called “monster camera” was a free-vehicle device that used bait to attract seafloor denizens and then “trapped” them in eye-opening photographs. It revealed for the first time the unexpected variety of creatures, including sharks and other large fishes, previously thought unable to survive on the deep seafloor, where it was assumed that nutrients were too sparse to support them. Isaacs regularly showed movies taken with the camera to Scripps biologists. These screenings caused excited discussions as scientists attempted to identify fishes, or remarked on their unexpected relationships and behaviors. *(For more information on the monster camera, go to page 34.)*

PROJECT MOHOLE RESURFACES

Another major NSF-supported project to emerge in the mid-1960s involved scientists from four oceanographic institutions. They were primarily geologists from Miami Institute of Marine Science, Lamont Geological Observatory, Woods Hole Oceanographic Institution, and Scripps who were interested in examining seafloor sediment to better understand the history of the oceans and Earth. The scientists had worked together on smaller drilling projects, and participated in the first phase of Project Mohole. During this ocean drilling project, they had attempted to retrieve samples of

Earth’s mantle by drilling a hole through Earth’s crust. Because of lack of funding, however, the project was discontinued before the second phase could be implemented. To draw upon the combined expertise of these scientists, the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES) was formed to develop and advise a new ocean drilling project, which had as its operational arm the Deep Sea Drilling Project (DSDP).

In 1966 Scripps signed a contract with NSF to manage the program, and according to



Professor Emeritus Edward Winterer, it was an immensely exciting time at Scripps. “DSDP engaged the attention of a whole lot of people here at Scripps in the earth sciences,” said Winterer, a Scripps geologist.

Administration of the program by Scripps made sense. From previous drilling expeditions, Scripps geologists knew how to handle and store the core samples aboard ships and were experienced with the laboratory tools needed to analyze them. To accommodate the increased activity, the institution had to recruit staff scientists and erect new buildings, including a warehouse-sized, refrigerated core locker. NSF also provided funding for a deep-sea drilling vessel.

Christened in 1968, the drill ship *Glomar Challenger* was 120 meters (400 feet) long; had the capacity to accommodate 70 scientists, technicians, and crew; and was outfitted with laboratories designed for geological research. It was capable of drilling at water depths of 6,000 meters (20,000 feet) into both sediment and the rock crust below. An early success on Leg 3—across the South Atlantic from Dakar, Senegal, to Rio de Janeiro, Brazil, from 1968 to 1969—generated great scientific excitement worldwide. The geologists intended to test the hypothesis of seafloor spreading—a theory

suggesting that the ocean floor spreads outward from underwater ridges to create new seafloor—by drilling at sites where the



age of the ocean crust had already been determined by magnetic data. They wanted to discover whether these ages would be confirmed by paleontological dating of the basal sediments.

The seafloor-spreading hypothesis was confirmed on this leg and provided the conceptual base upon which the theory of plate tectonics was built. According to plate tectonics, Earth’s surface is broken into large plates that change in size and position over time. Their movement causes intense geologic activity, such as earthquakes and volcanoes. “The Leg 3 drilling showed a near-perfect match, and seafloor spreading leaped from hypothesis to ruling theory in a single bound,” Winterer said.

Although originally intended to be an 18-month drilling program, the undeniable successes of DSDP led to continued NSF support. *Glomar Challenger* would drill for sediment cores from the Arctic to the Antarctic and

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George Hohnhaus (left) and Edward Winterer with seafloor basalt dredged off southern California in 1964.





Above, Art Flechsig and Rick Grigg aboard Sealab II (inset), a seafloor base for research divers.

RICK GRIGG: ONE MAN IN THE SEA

I **N 1965 THE UNITED STATES NAVY'S** Man in the Sea program, headed by John Craven, launched Sealab II. Its purpose was to explore the ocean, the inner space of planet Earth. Lyndon Johnson's Great Society had refocused part of our nation's space program back to Earth. Scott Carpenter, the second man to orbit our planet, was chosen as the team leader for the project. I too applied and was chosen by the Navy to be 1 of 30 aquanauts to live underwater at 205 feet for 15 days off Scripps.

Four other diver-scientists from Scripps joined 25 Navy career divers to round out the team. The Scripps ecology team of Art Flechsig, a research oceanographer, Tom Clarke, a fellow graduate student, and I, occupied the habitat for 15 days each, making our total period of observation 45 days.

The primary mission of Sealab II was to test humans' ability to live and work at significant depths on the continental shelf. The specific goals were threefold: to test human performance, to solve specific engineering problems, and to accomplish scientific research. The Scripps team's mission was to accomplish the third objective—to study how the habitat would affect fish ecology and bottom communities in the immediate area where the habitat was placed. 🌐

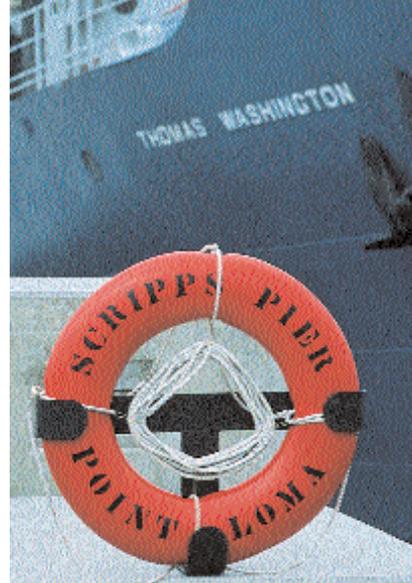
Excerpted with permission from *Big Surf, Deep Dives, and the Islands: My Life in the Ocean*, 1998, by Richard W. Grigg.

Richard Grigg is a 1970 Scripps graduate, and is director of the School of Ocean and Earth Science and Technology at the University of Hawaii.



Left, The Glomar Challenger, launched in 1968. **Right**, R/V Thomas Washington at the Nimitz Marine Facility in 1966.

Below, A drill bit used for deep-sea drilling.



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travel more than 603,000 kilometers (375,000 miles) before it was retired in 1984. DSDP was completed the same year and succeeded by the Ocean Drilling Program, which focuses on new scientific missions for JOIDES scientists.

FUNDING FOR THE FLEET

Another consideration for Nierenberg at this time was the institution's need for a permanent place to dock Scripps's growing fleet of research vessels. By the mid-1960s, Scripps owned 10 ships as well as the recently designed floating instrument platform known as FLIP. (See "Scripps Innovation at Its Best" on p. 32.) Without their own mooring, the vessels docked at either the Navy Electronics Laboratory on Point Loma in San Diego, or, depending upon availability, the San Diego city docks.

With funds from ONR and NSF, Scripps was able to consolidate its fleet at one pier and construct a marine facility from which to prepare equipment and ships for expeditions. Dedicated in 1966, the Chester W. Nimitz Marine Facilities, located on six acres adjacent to

San Diego Bay, comprise an administration building, several maintenance shops, a storage yard, and a warehouse. The facility was named for Fleet Admiral Chester W. Nimitz, who was also a University of California regent.

At the dedication ceremony, two new ships were introduced to the Scripps fleet: R/V *Alpha Helix* and R/V *Thomas Washington*. Both vessels soon proved themselves significant contributors to seagoing science. R/V *Thomas Washington* was especially instrumental in the success of Scripps's worldwide seagoing operations and research for nearly 20 years.

SCRIPPS VESSELS GO DIGITAL

In a joint research project with IBM, Scripps installed an IBM 1800 on R/V *Thomas Washington* to test the computer's capabilities as an effective piece of oceanographic equipment. On an expedition to the Eastern Tropical Pacific in 1967–1968, scientists aboard R/V *Thomas Washington* used the IBM 1800 to help record and evaluate more accurate biological, chemical, and physical data; the crew used

the computer to help make faster calculations for ship navigation.

As a result of the success of this and subsequent expeditions using the IBM 1800, a panel of Scripps scientists recommended the purchase of more 1800s for other Scripps ships, and advised the Shipboard Computer Group—formed to service shipboard computer programs and equipment—to

develop more computer programs to interface with other ship instruments.

By the end of the 1960s, Scripps was on the threshold of another major growth period, spurred by the federal government's increased interest in ocean sciences, the introduction of computer systems on research vessels, and the public's growing concern for the world's oceans. It was a time of opportunity, and under the aggressive leadership of William Nierenberg, the institution was poised to make great leaps in oceanographic science and technology. 🌐

