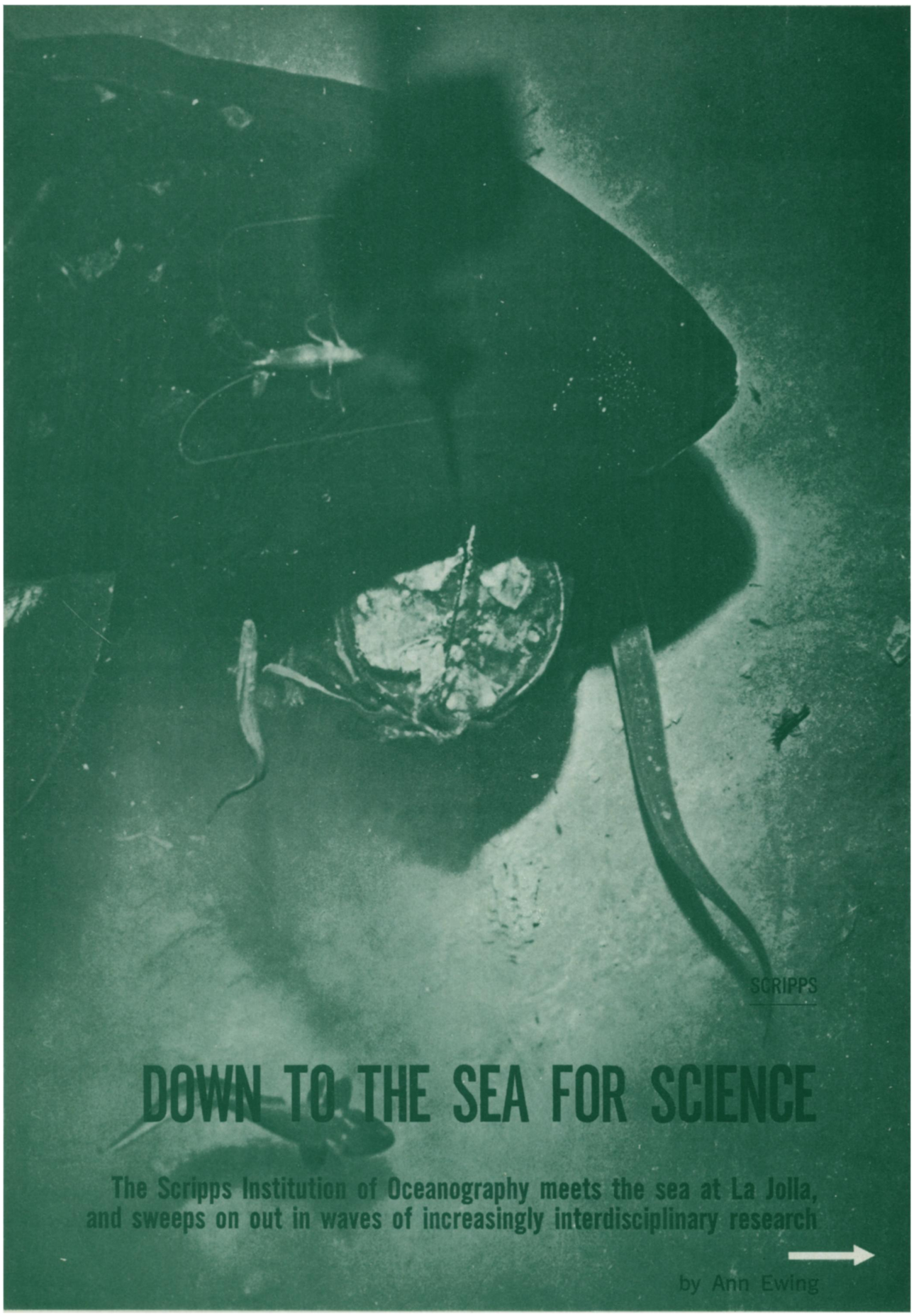


DOWN TO THE SEA FOR SCIENCE

The Scripps Institution of Oceanography meets the sea at La Jolla, and sweeps on out in waves of increasingly interdisciplinary research

by Ann Ewing

Oceanography has long been interdisciplinary, embracing physical, chemical, geological and geophysical as well as biological sciences. It is now binding them more tightly together than ever.

Meteorologists are discovering the profound role of the oceans and their temperature changes in large-scale weather patterns; oceanographers are probing the air above the seas for its impact on what goes on at and beneath the surface.

The air-sea interface absorbs more and more attention of the men who go down to the sea for science and is one of the main focal points of research at Scripps Institution of Oceanography, one of the most beautiful and most important centers of oceanographic research in the United States.

The buildings of this oceanographic branch of the University of California, San Diego, march down a relatively steep slope overlooking the gracefully curved, wave-washed beach at La Jolla.

For Scripps researchers, the sea is not only the focus of the pleasure of work but also a focus of the pleasure of pleasure. Bathing suits are common at lunchtime on warmer days, and some workers keep surfboards handy.

Scripps Institution was founded in 1903 as an independent biological research laboratory. It became part of the University of California in 1912, and was designated Scripps Institution for Biological Research in recognition of the interest and financial support of Miss Ellen Browning Scripps and her half-brother, E. W. Scripps, the publisher.

The institution's name was changed to the one now used in 1925, a recognition that the scope of the research program encompassed many more aspects than the biology of the sea.

Symbol of the still-broadening interest is Dr. William A. Nierenberg, formerly a professor of physics at the University of California's Berkeley campus. He has been director of Scripps since 1965.

Tall and powerful, Dr. Nierenberg—Bill to many of the staff—is a dynamo who vibrates enthusiasm about the varied programs at Scripps, describing them with a rapidity that would shatter most stenographers. The word on campus is that when he and oceanography professor Dr. John D. Isaacs, another tornado of motion and ideas, start a discussion, it proceeds at such a clip that few can follow the exchange.

But out of such exchanges come some exciting science and plans for exploration of the essential interface.

In undertaking the directorship, Dr. Nierenberg in a sense returned to his first love—geophysics. A graduate student at Columbia University, he was working on the propagation of earthquake waves and how their velocities vary in different directions, a field called finite strain. World War II interrupted this study and he received his doctorate in physics from Columbia after working under Nobelist Dr. I. I. Rabi on the Manhattan Project. His kind of interdisciplinary science not only dominates his institution; it is, by and large, the key to modern oceanography.

One of the current Scripps plans for investigating air-sea interaction to improve long-range oceanographic and meteorological forecasting will involve these disciplines in a vast area of the central North Pacific. Scripps scientists, in cooperation with the Office of Naval Research, will this year start probing an area four million miles square some 1,000 miles south of the Aleutian Islands.

For the pilot study, two clusters of four deep-moored instrument stations, under development since 1952, will be installed by Scripps and the navy north and northwest of Hawaii. The unmanned instrument stations have a catamaran structure.

Smaller instrument stations, moored in water 12,000 to 18,000 feet deep, will record surface wind speeds and directions, as well as water temperatures and salinity, at depths down to 1,500 feet. A separate station in each cluster will measure ocean currents. The moored instruments will also record barometric pressures, solar radiation levels and relative humidity.

The principal investigator for this study is Dr. Isaacs, 55-year-old director of the marine life research group whose white hair and nearly all-white beard frame a pair of sparkling blue eyes.

As do most oceanographers, Dr. Isaacs believes that one of the critical problems of ocean science is "to determine the nature and causes of the large-scale, persistent shifts in the temperature of the surface water," since these affect fish populations as well as weather. Continuing fluctuations along coastlines are well known, but only in the last decade has the fact that these local changes are related to variations involving entire oceanic regions become apparent. The North Pacific pilot study is aimed at learning whether the large-scale changes can be predicted.

The study will also include a sampling of plankton because these tiny life forms "constitute an important and exciting link with the recent past history of the ocean's boundary currents as recorded by varied layers of sediments in the coastal basins," Dr. Isaacs says.

The sediments are made up in part of the remains of the innumerable plankters that swarm in fertile seas. The relative populations of differing species, as laid down in the sediments, reflect water conditions of the past. Today's plankton trawls provide a baseline for the study.

Larger forms that feed on the plankton, and each other, are also the object of Scripps studies. To facilitate the research, Dr. Isaacs has designed a camera rig that penetrates the depths while luring hungry fish to itself.

The camera, attached to a 25-gallon can filled with fish, is dropped to the ocean floor from a ship, which can then proceed on other business. The rig automatically takes pictures of assaults on the can every five minutes.

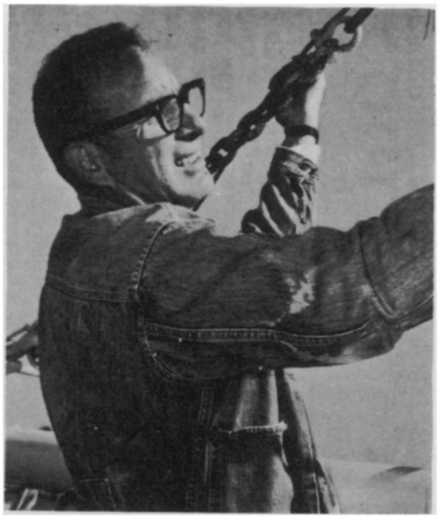
At a preset time, the camera releases itself and pops to the surface where it radios its position so the unit can be picked up.

Isaacs

Dr. John Isaacs' camera-equipped bait can attract a shark, complete with cleaner-shrimp, 15 kilometers down off Oahu, Hawaii.

University of California

Dr. Munk: Tides in the deep ocean.



University of California

Dr. Nierenberg: Few can follow.

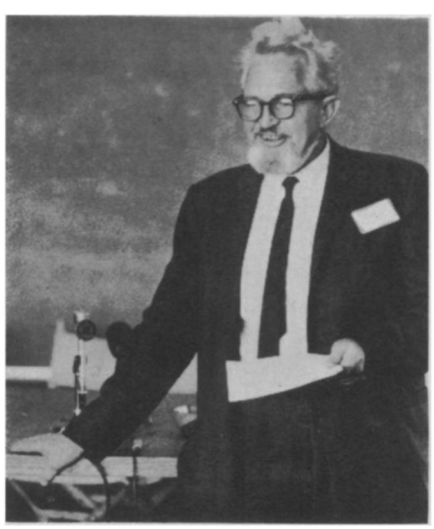
Glasheen Graphics

Aerial view of the Scripps Institution of Oceanography at the University of California, San Diego.

Although many had thought such deep ocean floors would be lifeless, Dr. Isaacs notes his photographs show "15 minutes is the longest time a fish-filled drum was open before some scavenger fish or other benthic life form found it and started eating the contents."

While the camera is below, the research vessel can make other studies, including work on the most visible and among the most important oceanic phenomena—the waves.

Work at Scripps and other institutions has led to methods of predicting waves and surf on beaches and advising ships at sea on the best routes for minimizing encounters with adverse wave conditions that might slow them.



University of California

Dr. Isaacs: "To determine the cause."

Viennese-born Dr. Walter H. Munk, now a naturalized citizen, is a world-recognized leader in this field. Dr. Munk is director of the Institute of Geophysics and Planetary Physics, a branch of the University of California located a few hundred feet north of the Scripps campus and intimately associated with it.

Dr. Munk has two offices—one near the imposing entrance where he conducts the administrative details, the other on a lower floor where he spends as much time as possible working on geophysics.

With Frank E. Snodgrass and other associates, Dr. Munk developed a method for dating and locating storms in the far South Pacific and Indian Oceans based on variations of the power spectrum of swells arriving on the southern California Coast.

The shift in time of the most prominent frequency in the observed swells, due to dispersion, gives the time since the train originated, and the velocity yields the distance. The direction is obtained by triangulation from the times of arrival of individual waves at several points.

Dr. Munk's most recent work is concerned with calculating and measuring the tides in the deep ocean directly from the fundamental equations of mechanics and astronomy. One aim of this study is to distinguish the periodic effects of the sun and moon from the irregular effects of wind, atmospheric pressure and local geometry in order to make more accurate predictions of destructive storm tides.

The instruments to do this, each handmade in the institute's workshops, are named after wives of staff members. The first two were called Dotty and Judith, for Mrs. Snodgrass and Mrs. Munk.

For his work on tidal friction and energy dissipation, Dr. Munk has been awarded the Gold Medal of the Royal Astronomical Society.

Scripps has another ambitious project to be launched this year: drilling at 70 sites through some four miles of water to penetrate up to 2,000 feet into the ocean bottom. This will be the biggest deep sea drilling project yet undertaken.

The oceanographers hope to determine how sea life represented in the cored sediments has varied over a wide area of the Pacific during the last several millions of years.

While the interface work proceeds, other scientists are also studying the transport of dissolved substances in the ocean, the geology and geography of the bottom, the behavior of sound, light and electromagnetic energy in the sea and the broad spectrum of oceanic biology.

Indeed, the search for understanding of the life in the sea has been one of the institution's prime purposes since its founding. The urgency of this search increases as the years go by and the world's population—and its hungry—continue to expand. With the expectation that there will be six billion people on this planet by the year 2000 there is a parallel need for growth in exploitation, as well as research, in the world's oceans.