at the forefront of research and training in the ocean and earth sciences that will provide needed understanding of these and other issues that affect our global environment.
Climate change, tsunamis, hurricanes, air pollution, and the loss of biodiversity are some of the issues that appeared in news headlines around the world this year. Scripps Institution of Oceanography continues to be at the forefront of research and training in the ocean and earth sciences that will provide needed understanding of these and other issues that affect our global environment.

In all basic measures of academic performance, Scripps had a good year. At the same time, we have not yet fully emerged from our financial difficulties, and state funding continues to diminish relative to the obligations the university is taking on.

When the books closed on the fiscal year, Scripps’s extramural funding totaled $130 million—an all-time high and 16.65 percent above last year’s funding, which was itself a record.

In graduate and undergraduate teaching, our Penner ratio (a number that reflects our volume of teaching) has reached 1.15, the highest in more than 30 years. In addition, we expect 49 new graduate students for the 2005-06 academic year, bringing the student body total to an all-time high of 250.

These figures, which measure the institution’s productivity, show that we are beginning to deliver on the promises we’ve made and give us great hope that the institution will soon return to a position of financial strength commensurate with our strength in research and teaching.

We received a new teaching position in recognition of our increasingly significant contributions to teaching from UCSD’s vice chancellor of academic affairs. This sort of recognition presages new opportunities for additional teaching positions and funding to help support the innovation and growth of Scripps’s education program.

Throughout fiscal year 2004-05, we continued to implement the basic provisions of the strategic plan that was created over the past couple of years to stabilize Scripps’s long-term fiscal health. The strategic plan included a charge to acquire funding for the development of large, interdisciplinary research endeavors. The breadth and depth of Scripps’s research gives us important advantages in this area. Among our funding gains was $12 million from a new source we set out to pursue two years ago—the state government agencies that are charged with management of California’s natural resources.

We have also engaged in significant new partnerships with BP, to improve our understanding of the seabed and the processes that shape it, and with the city of Venice, Italy, to provide fundamental information about the effects of sediment transport in Venice lagoon, ultimately to help that historic city in its efforts to control flooding.

In November 2005, Scripps will host the opening conference of the new Center for Earth Observations and Applications (CEOA), a Scripps-led, UCSD-wide endeavor that aims to integrate and provide focus for the work being done at Scripps and elsewhere at UCSD related to Earth observations and technologies.

CEOA is one of the major contributions that Scripps will make to a new UCSD environmental sustainability initiative that will link UCSD’s strengths in the biomedical, information, and earth sciences to the university’s strengths in the study of human affairs.

I have accepted the challenge, given to me by UCSD Chancellor Marye Anne Fox, to take the lead in designing and implementing this comprehensive sustainability initiative, a role I will undertake full-time beginning in September 2006.

Meanwhile, the chancellor will form a search committee to seek a new Scripps director, who will lead this institution into the next phase of its development.

Charles F. Kennel
The past 12 months have been one of the most intensive periods for natural disasters in recent years. We witnessed a relentless barrage of hurricanes striking Gulf Coast states, one of the largest earthquakes of the past century in the Indian Ocean, and a subsequent tsunami that killed nearly 300,000 people.

In response, the scientific community has sought to accelerate the pace of discoveries meant to improve society’s ability to analyze, predict, and respond to the hazards nature poses. Scripps Institution of Oceanography has long been a leader in such efforts. Increasingly, Scripps research is being carried out in partnership with private industry, relationships that are more than just good for business.

For instance, the past year has seen a surge of oil company activity incorporating the controlled-source electromagnetic measurement technology developed in large part by Scripps geophysicist Steven Constable and his colleagues. Backed by funding from more than a dozen sponsors, ranging from ExxonMobil to the Norwegian firm Statoil, this emerging exploration method promises to increase the efficiency of oil and gas discovery through the use of electromagnetic imaging. It can also be used to map seafloor gas hydrates, which have been implicated in global warming and in undersea landslides and ensuing tsunamis.

An investigation into the potential of hydrates to cause hazardous seafloor instability took place this spring. ChevronTexaco and the U.S. Department of Energy funded an exploratory cruise to the Gulf of Mexico, where members of the laboratories of Scripps’s Miriam Kastner and Neal Driscoll tested seismic imaging technologies and sample recovery through drilling.

In addition, BP recently announced that a three-year collaborative program with Scripps to study seafloor geohazards off the California coast will be expanded to a 10-year initiative. The joint venture is creating an observational network at a site off Santa Barbara known as the Goleta Slide. The network’s many components include autonomous underwater vehicle-based high-resolution bathymetry, acoustic geodesy, and fiber-optic strain monitoring. The area is believed to harbor the potential for slope failure and tsunami generation.

Also among the natural phenomena in the year’s headlines were heat waves around the world that were responsible for thousands of deaths. In many instances, power outages exacerbated the toll. Now the California Independent Systems Operator (CalISO), which runs California’s electricity grid, is working with Scripps climate researchers Tim Barnett and David Pierce to develop daily forecast models of the strength of the Sacramento–San Joaquin Delta breeze. CalISO will use the new information to improve its estimates of peak electricity usage on hot days, diminishing the likelihood of blackouts. Additionally, companies like tugboat line Sause Brothers and Surfline.com have recently given in-kind support to the Scripps-based Coastal Data Information Program, which delivers real-time marine data to a variety of users free of charge.

Of course, natural hazards exist on microscopic levels as well as on large geographic scales. A chemical compound first discovered at Scripps is the basis of a promising cancer drug that could be ready for human clinical trials by 2006. The San Diego firm Nereus Pharmaceuticals is licensed to develop therapeutic agents originating from bacteria of the genus Salinispora, which was identified by members of the Center for Marine Biotechnology and Biomedicine at Scripps. The drug could prove effective against multiple myeloma, a cancer of the blood.

Though we cannot prevent natural disasters and disease from happening, we can do much to improve the way we respond to them. With a growing number of partners in industry, Scripps Oceanography continues to help create products and technologies of benefit to society.
The California Space Institute (CalSpace), a multicampus research unit of the University of California, supports space and earth sciences, education, and technology. CalSpace scientists conduct pure and applied research in various interdisciplinary space-related fields. Many CalSpace researchers emphasize the atmosphere and atmosphere–ocean interactions. Some scientists study space plasma physics and planetary sciences, while others investigate Earth’s environment using remote sensing from satellites.

calspace.ucsd.edu

Center for Atmospheric Sciences

Researchers at the Center for Atmospheric Sciences (CAS) focus on fundamental investigations of the atmosphere related to large-scale climate change. To interpret and predict these changes, CAS scientists design and conduct field experiments, map out new satellite missions, and use regional and global atmospheric models. Their analyses include integration of the models with space and in situ observations.

www-cirrus.ucsd.edu

Center for Marine Biotechnology and Biomedicine

The Center for Marine Biotechnology and Biomedicine (CMBB), headquartered at Scripps, is a UCSD campuswide center dedicated to the exploration of potential biotechnological and biomedical resources from the world’s oceans. CMBB researchers conduct a broad range of investigations, from the special properties of deep-sea marine microbes to the genetic engineering of commercially important marine animals.

cmbb.ucsd.edu

Climate Research Division

In the Climate Research Division (CRD), scientists study phenomena spanning time scales from weeks to decades. They identify and predict the natural variability of climate and the consequences of anthropogenic increases in the greenhouse effect. CRD researchers use the principles of meteorology, oceanography, hydrology, and other disciplines to understand the complex interactions among the atmosphere, the seas, the land, and living things.

meteora.ucsd.edu

Geosciences Research Division

Scientists with the Geosciences Research Division (GRD) address a wide range of topics in the earth, ocean, and atmospheric sciences. GRD researchers study the physical, chemical, and geobiological processes of Earth’s mantle, crust, ocean, and atmosphere. They carry out detailed investigations in marine geology, petrology, paleomagnetism, tectonics, geophysics, isotope geology, geochemistry, mantle and crustal evolution, and paleontology.

grd.ucsd.edu
Institute of Geophysics and Planetary Physics

The Cecil H. and Ida M. Green Institute of Geophysics and Planetary Physics (IGPP) at Scripps is a branch of the University of California IGPP and hosts the system-wide office. Researchers at IGPP operate a global network of seismic stations (IDA); several modern seismic arrays; a permanent space geodesy network in California; an acoustic thermometry network in the North Pacific; and a variety of microwave and satellite data links to remote instruments at sea and on land. The institute also maintains an active seagoing program, including seafloor and deep-earth research using a fleet of ocean-bottom seismometers, measurement of gravity on the seafloor, a nonlinear processes laboratory, acoustic thermometry, and seafloor electromagnetics.

igpp.ucsd.edu

Integrative Oceanography Division

The Integrative Oceanography Division (IOD) was formed to allow collaborations between coastal physicists and biologists and to strengthen interdisciplinary capabilities in nearshore and offshore systems. In addition to collaborative research benefits, IOD is intended to be a base from which to develop a more interdisciplinary graduate student curriculum.

iod.ucsd.edu

Marine Biology Research Division

Scientists in the Marine Biology Research Division (MBRD) investigate the fundamental processes affecting life and energy flow in marine ecosystems. They examine biodiversity at multiple levels, from geographical and ecological to physiological and molecular. MBRD investigators explore a variety of habitats, including coral reefs, the deep sea, Antarctica, and coastal California.

mbrd.ucsd.edu

Marine Physical Laboratory

Scientists in the Marine Physical Laboratory (MPL) use knowledge of the ocean and its boundaries to perform basic research and solve problems in ocean acoustics, ocean optics, marine physics, marine geophysics, signal processing, and ocean technology. MPL scientists develop advanced ocean technology for in situ and remote environmental measurement programs and for testing new engineering concepts.

www.mpl.ucsd.edu

Physical Oceanography Research Division

Scientists in the Physical Oceanography Research Division (PORD) study a range of observational and theoretical topics related to the physics of the ocean. Some researchers study the large-scale circulation of the world’s oceans or the specifics of smaller environments such as the continental shelf, estuaries, or the shoreline. Others examine the interactions between the ocean and atmosphere. PORD scientists also develop new technologies such as autonomous drifters, specialized sensors, and new versions of current profilers.

pord.ucsd.edu
In fiscal year 2005 we expanded our education program to include classes for preschool kids. Of course we believe that one's interest in the ocean cannot start at too young of an age! At the other end of the age spectrum, we introduced more teacher training programs in ocean science in collaboration with the Marine Activities, Resources and Education program at the Lawrence Hall of Science at University of California, Berkeley. As an added bonus this year, we were very excited to have been able to include five teachers from the Tijuana municipal schools in a three-day ocean workshop. We will continue to partner on education projects with our neighbors to the south in the coming year.

Once again, one of the highlights of the year was the Scripps Nierenberg Prize for Science in the Public Interest. In April 2005, Sir David Attenborough received this honor during a ceremony at Birch Aquarium. Sir David delighted us all with an entertaining and insightful glimpse into the life of a natural history filmmaker.
Scripps Institution of Oceanography continues to attract exceptional graduate students in its oceanography, marine biology, and earth sciences programs while at the same time setting record highs in student enrollment. In Fall 2004, 44 new students were admitted to graduate study; in Fall 2005, we expect 49 new graduate students. This will bring the number of students enrolled at Scripps to an all-time high of 250.

As part of their studies, graduate students participate in research both at Scripps and throughout the world. Their work plays a vital role in Scripps’s mission to seek, teach, and communicate scientific understanding of our oceans, atmosphere, Earth, and other planets for the benefit of society and the environment.

Jessica Meir, a graduate student in marine biology, joined the Scripps SEDiment research group to study the effects of sediment translocation in Venice, Italy. The team was there as part of a joint effort with the Venice Water Authority to help with the ecological improvement of the historic city.

Throughout the 2004-05 academic year, a number of students received awards for their research. Benjamin Hodges, a graduate student in physical oceanography, was selected as the winner of the 2005 Edward A. Frieman Prize, an annual recognition of excellence in graduate student research at Scripps. As the 10th recipient of the Frieman Prize, Ben was honored for his research paper that was published in the August 2004 issue of Deep Sea Research Part I.

At the December 2004 American Geophysical Union (AGU) conference held in San Francisco, Renee Bulow, a graduate student in geophysics, won the Outstanding Student Paper Award for Planetary Science for her poster and Melissa Headly, a graduate student in climate science, won the Best Student Paper Award for Paleoclimate and Palaeoceanography for her poster. At the Spring 2005 AGU joint Assembly meeting in New Orleans, Leah Hogarth, a graduate student in geosciences, received the Outstanding Student Paper Award for her poster.

Scripps faculty continue to be the teaching force for the Earth Sciences Program at UCSD. Enrollments are at a record high, and nearly every lower division class is filled to capacity.

In fall 2004, earth sciences major Elise Sbarbori was one of 20 undergraduates to receive the UCSD Physical Sciences Dean’s Undergraduate Award for Excellence in recognition of her outstanding academic performance and her research achievements under the guidance of Joel Norris in the Climate Research Division. Lelia graduated in Spring 2005 and will continue her graduate studies at Scripps this fall.

In 2004–05, Scripps faculty introduced several new undergraduate biology classes that were filled to capacity in their first year. The goal, in collaboration with the Division of Biological Sciences at UCSD, is to create an undergraduate major specialization in marine biology. The initial response from students suggests that the program will be in high demand.
Curricular Groups

The Graduate Department of Scripps Institution of Oceanography offers instruction leading to Ph.D. degrees in oceanography, marine biology, and earth sciences. Because of the interdisciplinary nature of the ocean sciences, the department provides a choice of eight curricular groups through which the student may pursue a Ph.D. degree. Each group has prerequisites for admission in addition to the departmental requirements.

Applied Ocean Science (AOS)
This interdepartmental program serves as a bridge between the classical disciplines of biological, geological, and physical oceanography and the UCSD engineering departments. The aim of the AOS program is to develop scientists capable of designing and operating novel instrumentation in support of ocean research, as well as analyzing and interpreting the data.

Biological Oceanography
In the biological oceanography curriculum, the interactions of marine organisms with the physical–chemical environment and with each other are studied. Research and instruction in this curriculum range from food-web dynamics and community structure to systematics, behavior, biogeography, and physical–biological interactions.

Climate Sciences
The climate sciences curriculum concerns the study of the climate system of the earth with emphasis on the physical, dynamical, and chemical interactions of the atmosphere, ocean, land, ice, and the terrestrial and marine biospheres. The program includes investigations of changes on seasonal to interannual time scales, changes induced by human activities, and paleoclimatic changes on time scales from centuries to millions of years.

Geological Sciences
This curriculum applies observational, experimental, and theoretical methods to the understanding of the solid earth and the solar system and how they relate to the ocean and the atmosphere. Principal subprograms are marine geology and geophysics, tectonics, sedimentology, micropaleontology and paleoceanography, petrology and geochemistry, and isotope geology. Expedition work at sea and fieldwork on land are emphasized as essential complements to laboratory and theoretical studies.

Geophysics
This curriculum educates the student about the physics of the solid earth, including the earth’s magnetic field, the mechanics of tectonic processes, earthquakes and the waves they produce, the physics of the earth’s interior, and mathematical methods for analyzing data and interpreting them in terms of models of the earth. Physical and mathematical approaches to geophysical research are emphasized.
Marine Biology
The marine biology curriculum emphasizes course work, seminars, and research on all aspects of the biology of marine organisms. Teaching and research focusing on both prokaryotes and eukaryotes encompass the disciplines of cell and molecular biology, biochemistry, developmental biology, physiology, biomechanics, genetics, ecology, and evolutionary biology.

Marine Chemistry and Geochemistry
The marine chemistry and geochemistry curriculum emphasizes the chemical and geochemical processes operating in the oceans, atmosphere, and other environments, and includes the subdiscipline of marine natural products chemistry. Education and research in this curriculum combine field observations with laboratory or mod-


DOCTOR OF PHILOSOPHY DEGREES AWARDED WITH TITLES OF DISSERTATIONS

EARTH SCIENCES
Adrian Antal Borsa
“Geomorphology of the Salar de Uyuni, Bolivia”

Scott L. Nooner
“Gravity Changes Associated with Underground Injection of CO2 at the Sleipner Storage Reservoir in the North Sea, and Other Marine Geodetic Studies”

Bridget R. Smith
“Three-Dimensional Deformation and Stress Models: Exploring One Thousand Years of Earthquake History Along the San Andreas Fault System”

MARINE BIOLOGY
Matthew Thomas Craig
“Molecular Phylogenetics of the Serranid Subfamily Epinephelinae: Speciation and Biogeography in a Nearshore Marine Fish Clade”

Jeanine Marie Donley
“Mechanics of Steady Swimming and Contractile Properties of Muscle in Elasmobranch Fishes”

David I. Kline
“The Effects of Anthropogenic Stress on Coral Holobiont: New Insights into Coral Disease”

Silvia Armitano Mah
“Molecular Analysis of Sea Urchin Sperm Receptor Proteins Containing Receptor for Egg Jelly (REJ) Modules”

Chugey Jesus Alejandro Sepulveda
“Aspects of the Evolution and Adaptive Significance of Regional Endothermy in Fishes”

Jr-Kai Yu
“Fox (Forkhead/Winged Helix) Family Genes in the Cephalochordate Amphioxus”

OCEANOGRAPHY
Bonnie Becker
“The Regional Population Variability and Larval Connectivity of M ytilid Mussels: Conserving the Populations of Cabrillo National Monument (San Diego, CA)”

Joannes Berque
“Antarctic Cloud and Surface Properties: Satellite Observations and Climate Implications”

Chad A. English
“The Role of the Pressure Field in Wind-Driven Coastal Circulation”

Megan Caton Ferguson

David Buurmsa Field
“Planktonic Foraminifera in the California Current: Vertical Distribution, Decadal Scale Climate Variability, and 20th Century Warming”

Elizabeth R. Frame
“Myosporine-like Amino Acids (MAAs) in Bloom-Forming Phytoplankton: Influence of Nitrogen, Ultraviolet Radiation, and Species Composition”

Eric M. Giddens
“Geoacoustic Inversions Using Sound from Light Aircraft”

Erica Goetze
“Speciation in the Open Ocean: The Phylogeography of an Oceanic Copepod Family”

Grace Engfang Lim
“Bugula (Bryozoa) and Their Bacterial Symbionts: A Study in Symbiosis, Molecular Phylogenetics, and Secondary Metabolism”

Jessica D. Lundquist
“The Pulse of the Mountains: Diurnal Cycles in Western Streamflow”

Joseph Patrick Martin
“Internal Tides and Mixing in the Upper Ocean at the Hawaiian Ridge”

Tracy John Mincer
“Phylogenetic and Ecological Investigations of Secondary Metabolite Producing Marine Bacteria and Their Potential for Biotechnology”

Christian Perry Ridley
“Chemical and Biological Studies of Marine Natural Products and Marine Invertebrate/Bacterial Symbiosis”

Andrey Shcherbina
“Dense Water Formation on the Northwestern Shelf of the Okhotsk Sea”

Karen M. Shell
“A New Type of Idealized Climate Model and Its Application to Dust–Climate Implications”

Matthew S. Spydell
“Baroclinic Long-Wave Basin Modes and Oceanic Wind-Driven Low-Frequency Variability”

MASTER OF SCIENCE DEGREES AWARDED

EARTH SCIENCES
Robert Comstock
Samuel J. Rigby

OCEANOGRAPHY
Jessica MacFarland
Carolyn Scearce

For application procedures or for more information, please write to:
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scripps.ucsd.edu/grad_dept
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from July 1, 2004 – June 30, 2005

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Andrew A. Benson, MBRD, Marine Biology
Jonathan Berger, IGPP/CSI, Geophysics
Wolfgang H. Berger, GRD, Oceanography
Bruce G. Bills, IGPP, Planetary Sciences
Donna K. Blackman, IGPP, Marine Geophysics
Yehuda Bock, IGPP, Geochemistry
Andre Bornemann, GRD, Geosciences
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Theodore Bunch, GRD, Geology
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Amanda Demopoulos, IOD, Oceanography
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Shenfu Dong, PORD, Physical Oceanography
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Amos Dotan, MPL, Electrical Engineering
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Nicholas D. Holland, MBRD, Marine Biology
Osmund Holm-Hansen, MBRD, Marine Biology

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M. Gabrielle Laske, IGPP, Geophysics
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Yuguo Li, IGPP, Geophysics
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Ralph Lovberg, PHYS, Physics
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Frank L. Vernon, IGPP, Seismology
Fabrice Veron, MPL, Oceanography
Roland E.A. Von Glasow, CAS, Atmospheric Physics (Meteorology)
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Emertus, on site
Faculty, Department of Scripps Institution of Oceanography
Frieman Chair
John B. Isaacs Chair
Postgraduate research/Postdoctoral scholar
Ritter Chair
Norsanirad, affiliated elsewhere
Member of Scripps Institution of Oceanography Faculty
Visiting Scholar

CAS Center for Atmospheric Sciences
CMBB Center for Marine Biotechnology and Biomedicine
CRD Climate Research Division
CSI California Space Institute
DO Director’s Office
ECE Electrical and Computer Engineering Department
GRD Geosciences Research Division
IGPP Institute of Geophysics and Planetary Physics
INLS Institute for Nonlinear Science
IOD Integrative Oceanography Division
MBRD Marine Biology Research Division
MPL Marine Physical Laboratory
PHYS Physics Department
PORD Physical Oceanography Research Division
SGP Sea Grant Program
SIO Scripps Institution of Oceanography Graduate Department
SOMTS Ship Operations and Marine Technical Support
STS Shipboard Technical Support
The Scripps Institution of Oceanography fleet completed a busy year of support to seagoing science. The wide range of disciplines, observational methods and tools, technical support requirements, ship capabilities, and geographic locations of study areas forms a substantial challenge. That this challenge was met and that most scientific objectives were accomplished or exceeded is primarily due to the talent and effort of the ships’ crews and technical support staff.
R/V Roger Revelle

R/V Roger Revelle began the year off the coasts of South and Central America at the Galapagos Triple Junction where the Pacific, Cocos, and Nazca plates meet. At this site, scientists conducted a geophysical survey to establish the plate tectonic and structural history of the past 10 million years. This cruise was followed by a project at the East Pacific Rise in which electromagnetic techniques that image the electrical conductivity of the seafloor were used. These techniques succeed because conductivity is a strong function of fluid content—whether magma or seawater—beneath the seafloor bottom. Two geophysical surveys to conductivity of the seafloor were used. These techniques succeed because conductivity is a strong function of fluid content—whether magma or seawater—beneath the seafloor bottom. Two geophysical surveys to the Gulf of California followed, to collect data that will allow interpretation of the structure and tectonic history of the gulf.

In late spring after a short break at home port, Revelle departed for a new expedition beginning with the U.S. Navy’s Long-range Ocean Acoustic Propagation Experiment (LOAPEX) that set vertical receiving arrays near the island of Kauai for future coordinated experiments. This was followed by a project for NOAA’s Undersea Research Program to the Aleutian Islands and Gulf of Alaska. The expedition included several science programs from varied disciplines, all using JASON II, a remotely operated vehicle. While on transit to Dutch Harbor from Honolulu, scientists used JASON II to recover an instrument lost on a previous cruise. Revelle returned to Honolulu to carry out a seafloor geodesy project in Hawaiian waters, which was followed by an ocean acoustic cruise, the Basin Acoustic Seamount Scattering Experiment (BASSEX), south of Hawaii before returning to San Diego. A California Cooperative Oceanic Fisheries Investigation cruise was carried out in the fall from home port before Revelle departed on the final cruise of the year to support a biochemical study of plankton dynamics and carbon cycling in the equatorial Pacific.

R/V Melville

R/V Melville began the year working off northern Australia and the Fly River Delta of Papua New Guinea for the National Science Foundation’s MARGINS Program, supporting multidisciplinary studies of the sediment dynamics in this region. This work required comparing seasonal variations in river runoff—the source of sediments—and focused on the mechanisms and rates of sediment dispersal within the Fly River Delta. The continental shelf in the Gulf of Papua contains a distinct clinoform feature, a relatively abrupt depth change between the shallow inshore seafloor and the deeper offshore portion of the shelf. This feature is crossed by several channels that are significant elements of the processes that distribute sediments from the river to the shelf and ultimately move some portions of the sediment inputs into deeper waters offshore. This program continued through May after which Melville transited to Yokohama to begin a Climate Variability and Predictability (CLIVAR) Repeat Hydrography Program section of closely spaced stations from surface to bottom along a transect (30 N) from Japan to California. Measurements at each station included concentrations of carbon cycle components and other chemical tracers in addition to standard variables such as temperature, conductivity, and dissolved oxygen. CLIVAR is an international research program addressing many issues of natural climate variability and anthropogenic climate change. Understanding the rate at which the deep ocean can absorb carbon dioxide (anthropogenic or other) from the atmosphere, and changes over time in the deep-ocean inventory of carbon, are key to assessing how natural systems will respond to the anthropogenic forcings. Upon arrival at San Diego, August 27th, Melville set a record among Scripps research vessels for the longest time ever away from home port: 754 days and 76,238 nautical miles after leaving port on August 5, 2002.

After a brief stop in San Diego, Melville sailed as part of a two-ship operation (LOAPEX) with Roger Revelle to improve understanding of long-range ocean acoustic propagation, deploying a ship-suspended low-frequency acoustic source. Roger Revelle deployed a towed receiver as part of the BASSEX program. In addition, transmitted signals were received on the vertical line array deployed earlier in the year by Revelle during the SPICE04 cruise and on U.S. Navy hydrophone arrays around the North Pacific. LOAPEX, SPICE04, and BASSEX are the three components of the 2004–05 Office of Navy Research funded North Pacific Acoustic Laboratory field program. A transect to carry out measurements of oceanic iron concentrations brought Melville home from Hawaii.

On New Year’s Eve, Melville departed San Diego to begin a new expedition to Hawaii and into the South Pacific.

R/V New Horizon

The 2004 schedule of R/V New Horizon exhibited wide scientific variety. The year began with a cruise to test a new sonar system designed to detect marine mammals. Such a device would allow future investigators to modify planned experiments in real time in order to mitigate any risks to mammals in the region of interest. This work was followed by a baseline study within the Cowcod Conservation Area off southern California. Three cruises were carried out using an autonomous bottom-transecting instrument for making long time-series measurements of phytoplankton fluorescence and acoustically detectable sediment structure to abyssal depths. New Horizon carried out a number of tests of new instruments being developed for later use in more complex experiments on larger vessels in more remote areas of the world.

Most of New Horizon’s cruises took place off California. Exceptions included a pilot study of the use of marine electromagnetic techniques to map the extent and quantity of gas hydrates and a study of coastal ocean circulation and biological structure, both off the Oregon coast. In Mexican waters, New Horizon transited to the
Guaymas Basin in the Gulf of California for a comparative study of alkenone production and biological productivity, contrasting the results with those from other sites in the North Pacific. Also in Mexican waters, New Horizon completed a five-year investigation of marine benthic population dynamics under the NSF Biocomplexity Initiative. At the end of the year, New Horizon was used to help scientists quantify the effects of the cold seep source in the San Clemente Fault on the chemical signature preserved by barite in marine sediments near the fault and in the San Clemente Basin, in both the U.S. and Mexican Exclusive Economic Zones.

**R/V Robert G. Sproul**

*R/V Robert G. Sproul* serves as our versatile small research ship, and is often treated as an adaptable extension of the chief scientist’s laboratory test bench. Available on relatively short notice and extremely flexible, *Sproul* offers scientists the opportunity to test equipment, make trial specimen collections and instrument deployments, and carry out other projects suited to the smaller size of the ship. The year 2004 was no exception as *Sproul* carried out nearly 34 separate cruises, each requiring the ship to be loaded, outfitted for the particular demands of the intended project, and then unloaded. Research spanned a broad spectrum of physical, chemical, biological, geological, geophysical, and marine acoustical investigations. *Sproul* also plays an important role in education. What better way for teachers and students alike to gain oceanographic research experience than participating in a real scientific voyage. The frequent occurrence of short cruises on *Sproul* presents numerous opportunities for oceanography students to participate and learn, without unduly impacting class schedules. The year’s schedule included a biological oceanography class from the University of San Diego and the Enduring Resources for Earth Science Education summer workshop giving the middle- and high-school teacher participants a firsthand look into the world of oceanography and the seagoing scientist.
Making a difference for San Diego County residents, for all Californians, across the United States, and around the globe, Scripps Institution of Oceanography is bringing solid science to bear on environmental, economic, and social challenges.

In cooperation with academic and business partners all over the world, Scripps scientists are addressing challenges to human society in several ways:

- When is it safe to be on the beaches in southern California?
- How will the water supply that we rely on for drinking, energy production, and irrigation be affected as the snowpack shrinks in the Sierra Nevada mountain range?
- Will people have the antibiotics they need when current pharmaceuticals are no longer effective?
- How does human habitation affect near-shore marine environments?
- How will the emperor penguin population be affected as the Antarctic ice sheets warm and change?
- Will the placement of flood-control gates in Venice, Italy, cause the toxins in lagoon-bottom sediments to rise to the surface, posing health risks?
- How should warning and communication systems be deployed to help those living along the Indian Ocean and other coastlines avoid future tsunami devastation?
Those who contribute gifts are making a difference by enabling Scripps to expand its research programs, recruit and retain outstanding scientists, attract increasing numbers of exceptional graduate students, host scientific meetings and conferences, and extend its outreach through the Birch Aquarium at Scripps.

Private gifts during the past three years have exceeded $25 million, a figure nearly equivalent to the total contributed during the previous five years. The SIO Council, the SIO Director's Cabinet, the E. W. Scripps Associates, the Friends of the Collections, the Scripps Environmental Advocates, those who participate in Ellen's Circle, and the members of the Scripps Oceanographic Society all play important roles in the teaching, research, and public communication programs of the institution.

Salah Hassanein, former chairman of Warner Brothers and a member of the SIO Director's Cabinet, observed that this world-leading institution does not have an international volunteer leadership structure to match its global scope. Instead of just identifying that deficiency, Hassanein has agreed to lead such a group, and has actively worked with us to recruit a very impressive European leadership team as the first component of a global volunteer structure.

Last year I mentioned that Audrey Geisel directed a gift that was used to provide the first Career Development Award. The Henry L. and Grace Doherty Foundation subsequently provided a $500,000 challenge grant to stimulate additional gifts for that program, which is designed to help Scripps recruit and retain exceptional scientists early in their careers. The Doherty Foundation grant will be used as an endowment fund, with the earnings to support a new Career Development Award every five years. Two $100,000 matching gifts—from the Legler Benbough Foundation and from the E. W. Scripps Associates—have been received, so the remaining matching requirement stands today at $300,000. The outstanding young scientists supported through this program will be at the forefront of scientific research and teaching in the years to come.

Private giving is also increasing for programs at the Birch Aquarium at Scripps. The Art of Deception and EARTHQUAKE! Life on a Restless Planet exhibitions, for example, were supported by a number of meaningful gifts in amounts ranging from $2,500 to $25,000.

There are many ways to benefit science and society through gifts—large and small—to Scripps. On behalf of all those associated with Scripps, I sincerely thank each person who chose to make a gift this past year.

[Signature]

[Image]
Awards and Honors

Graduate student Simone de Leuw received the Heitfeld Prize in Geology from the Westfalian Wilhelms University in Münster, Germany.


Charles D. Keeling received the Tyler Prize for Environmental Achievement.

Guy Masters was elected to fellowship in the Royal Society.

Enric Sala was named a 2005 Aldo Leopold Leadership Fellow.

Two Scripps staff members received Equal Opportunity/Affirmative Action and Diversity Awards from UCSD: head of Web Operations, Wayne Suiter, and academic administrator for the Center for Marine Biodiversity and Conservation at Scripps, Sarah Mesnick, who has a joint appointment with the Southwest Fisheries Science Center.

Brad Tebo was elected to the American Academy of Microbiology.

Paul Dayton received the 2004 NOGI Award, science category, from the Academy of Underwater Arts and Sciences.
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Elizabeth Verrick
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Crown Point Catering
Culinary Concepts
Discovery Channel
Festivities Catering
The French Gourmet
Gencorp
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ITLA Capital Corporation
Peartrees Catering
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San Diego National Bank
Time Warner Cable
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Scripps Oceanographic Society (SOS) Members
Special thanks to our 7,015 members
whose membership dues help support the
Birch Aquarium at Scripps and Scripps Institution
of Oceanography operations.
Scripps Institution of Oceanography (SIO) has established a working site on the California Digital Library’s eScholarship Repository. Digital repositories are a new means of cataloging, disseminating, and archiving digital documents. Scripps’s site on the repository provides the opportunity to publish technical reports at the institutional, divisional, program, and individual principal investigator levels. The repository can also be used for peer-reviewed series and on-line journals, as well as researcher contributions, which are no longer listed in this section.

You can visit the eScholarship Repository (http://repositories.cdlib.org/sio) for more information. Currently, the Scripps working site includes the following: Coastal Morphology Group, SIO Technical Report Series, SIO Archives, SIO Library, and the Center for Marine Biodiversity and Conservation.

Naga Report Series
The Naga Report Series covers the scientific results of marine investigations in the South China Sea and the Gulf of Thailand from 1959 through 1961. For a list of available reports, visit siolibrary.ucsd.edu/guide/siopublns.html.

Publications for Members of the Scripps Oceanographic Society
Members of the Scripps Oceanographic Society receive two publications as a membership benefit. The quarterly newsletter OnBoard lists upcoming aquarium events and activities, features short articles highlighting exhibits and programs, and interprets the science that supports them. Members also receive Scripps Institution of Oceanography Explorations that features the cutting-edge research taking place at Scripps. Explorations is published quarterly, including an annual video edition. For more information, visit explorations.ucsd.edu.

California Sea Grant Publications
As part of the Sea Grant program, California Sea Grant sponsors research on coastal and marine resources, and helps solve contemporary marine-related problems by communicating its research results to industry, government, and the public.

For more information on California Sea Grant publications (including the Reference Series, Technical Series, newsletters, and abstracts), visit www-csgc.ucsd.edu.

Bulletin
Published by the University of California, the Bulletin of the Scripps Institution of Oceanography is a series of original monographic research written by Scripps scientists. For information about the series (including a bibliography, Bulletin issues available from the SIO library, and issues available for purchase from the University of California Press), visit siolibrary.ucsd.edu/guide/siopublns.html.

CalCOFI Publications
The work of the California Cooperative Oceanic Fisheries Investigations (CalCOFI), in which Scripps Institution of Oceanography, the California Department of Fish and Game, and the National Marine Fisheries Service cooperate, is published in a variety of formats. Peer-reviewed scientific articles are published annually in the California Cooperative Oceanic Fisheries Investigations Reports. Maps of physical, chemical, climatological, and biological factors measured by CalCOFI researchers during the program’s 53-year history are published irregularly in the California Cooperative Oceanic Fisheries Investigations Atlas Series. Data reports, containing the processed data from quarterly cruises carried out under CalCOFI sponsorship, were previously published in the SIO Reference Series and are available on the CalCOFI website: www.calcofi.org.
Scripps Institution of Oceanography has modified its reporting to better communicate its financial activity in a format that is more compatible with standard business reporting practices. This modification has resulted in a difference in totals when compared with previous annual reports.

This statement does not purport to present all annual expenditures associated with operating the institution. Many services provided by campus departments outside of Scripps are not reflected in the annual expenditures of the institution. Examples of campus-provided services include building construction and maintenance, parking lot and road maintenance, utilities, seawater utilities, custodial services, landscaping and grounds maintenance, accounting, payroll, and personnel services.
### Revenues

<table>
<thead>
<tr>
<th>Sponsored Research (funded in this period, not awarded)</th>
<th>FY 03-04</th>
<th>FY 04-05</th>
<th>UNRESTRICTED</th>
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<tbody>
<tr>
<td>Government: Federal</td>
<td>92,705,412</td>
<td>92,282,510</td>
<td>92,282,510</td>
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<tr>
<td>National Science Foundation</td>
<td>31,996,642</td>
<td>42,319,703</td>
<td>42,319,703</td>
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<tr>
<td>Department of the Navy</td>
<td>19,156,644</td>
<td>15,393,914</td>
<td>15,393,914</td>
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<tr>
<td>National Oceanic and Atmospheric Administration</td>
<td>16,520,606</td>
<td>17,233,918</td>
<td>17,233,918</td>
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<tr>
<td>National Aeronautics and Space Administration</td>
<td>4,708,521</td>
<td>4,336,711</td>
<td>4,336,711</td>
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<tr>
<td>Department of Energy</td>
<td>1,457,001</td>
<td>1,644,596</td>
<td>1,644,596</td>
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<tr>
<td>Other departments of defense</td>
<td>538,598</td>
<td>187,473</td>
<td>187,473</td>
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<tr>
<td>Other federal departments</td>
<td>4,085,137</td>
<td>2,526,097</td>
<td>2,526,097</td>
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<tr>
<td>Federal flow through (subcontracted research with nonstate institutions)</td>
<td>8,242,263</td>
<td>9,643,098</td>
<td>9,643,098</td>
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<tr>
<td>Government: State</td>
<td>2,601,311</td>
<td>4,122,929</td>
<td>4,122,929</td>
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<tr>
<td>Government: Local</td>
<td>510,298</td>
<td>401,203</td>
<td>401,203</td>
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<tr>
<td>Private contracts</td>
<td>1,565,731</td>
<td>3,561,028</td>
<td>3,561,028</td>
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<tr>
<td>University of California Support</td>
<td>23,112,195</td>
<td>24,795,234</td>
<td>3,473,113</td>
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<td>General funds from the state that flow through UCSD</td>
<td>15,432,725</td>
<td>15,822,691</td>
<td>16,051,845</td>
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<tr>
<td>Student fees</td>
<td>900</td>
<td>3,800</td>
<td>3,800</td>
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<tr>
<td>Allocation of benefits for UCSD full-time employees</td>
<td>2,624,200</td>
<td>2,718,243</td>
<td>2,718,243</td>
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<tr>
<td>Intercampus sponsored research</td>
<td>392,576</td>
<td>754,870</td>
<td>754,870</td>
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<tr>
<td>ICR allocation from prior year F&amp;A fees from UCSD</td>
<td>4,661,793</td>
<td>5,495,631</td>
<td>1,509,380</td>
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<tr>
<td>Earned Revenue</td>
<td>6,408,771</td>
<td>6,096,003</td>
<td>5,677,063</td>
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<tr>
<td>Birch Aquarium-Museum at Scripps revenue&lt;sup&gt;1&lt;/sup&gt;</td>
<td>2,801,795</td>
<td>2,685,802</td>
<td>2,685,802</td>
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<tr>
<td>Recharge unit revenues generated from external parties</td>
<td>3,303,007</td>
<td>2,991,261</td>
<td>2,991,261</td>
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<tr>
<td>Intellectual property and royalty income</td>
<td>3,041</td>
<td>10,142</td>
<td>10,142</td>
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<tr>
<td>Other revenue</td>
<td>300,929</td>
<td>408,798</td>
<td>408,798</td>
</tr>
<tr>
<td>Private Gifts and Grants</td>
<td>4,532,163</td>
<td>5,462,794</td>
<td>4,632,212</td>
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<tr>
<td>Private gifts&lt;sup&gt;2&lt;/sup&gt;</td>
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<td>3,743,483</td>
<td>3,743,483</td>
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<tr>
<td>Private grants</td>
<td>732,090</td>
<td>1,719,311</td>
<td>1,719,311</td>
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<td>Interest Income</td>
<td>1,314,276</td>
<td>1,812,648</td>
<td>838,787</td>
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<tr>
<td>Interest income</td>
<td>29,695</td>
<td>29,383</td>
<td>29,383</td>
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<tr>
<td>Endowment yields</td>
<td>1,284,580</td>
<td>1,812,648</td>
<td>838,787</td>
</tr>
<tr>
<td>Other Income</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Revenue</td>
<td>132,750,156</td>
<td>138,563,732</td>
<td>109,312,584</td>
</tr>
</tbody>
</table>

### Expenses

| Research programs: Seek<sup>3</sup> | 117,552,379 | 117,488,739 |
| Instruction programs: Teach<sup>5</sup> | 5,617,480 | 5,452,616 |
| Outreach: Communicate                   | 5,026,844 | 4,882,092 |
| Birch Aquarium-Museum at Scripps<sup>4</sup> | 3,734,728 | 4,032,901 |
| Scripps Oceanographic Society           | 257,192 | 233,005 |
| Communications and publications         | 1,034,924 | 616,186 |
| Institutional Support                   | 4,129,713 | 5,213,427 |
| Director's Office<sup>6</sup>           | 1,492,600 | 1,712,731 |
| Development: Direct costs<sup>7</sup>   | 405,644 | 503,001 |
| Special events and facility rental      | 183,848 | 163,798 |
| Director's Business Office<sup>8</sup>  | 776,519 | 816,255 |
| Academic and research investments<sup>9</sup> | 69,034 | 116,153 |
| Facility expenses                       | 665,444 | 1,321,984 |
| Support services<sup>10</sup>           | 536,624 | 579,504 |
| Total Expenses<sup>1</sup>              | 132,326,416 | 133,936,874 |

Net carry forward (deficit) from current activities | 423,740 | 5,526,858 |

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1. Like most museums, the Birch Aquarium-Museum at Scripps generates only a portion of its expenses through fees it charges to the public (67% in FY 05). The balance of its operations is supported through restricted private gifts.
2. Private gift revenue includes gifts received and available for spending in the current year. It does not include development activity resulting in bequests, pledges, or contributions to endowments or funds acting as endowments.
3. UCSD financial schedules exclude overhead generated from sponsored research activities. Scripps administration includes it in these financial statements to improve comparisons of Scripps to other research institutions.
4. Research programs include all research units, the Marine Science Development Shop, the Analytical Facility, Collections and Libraries, and Contracts and Grants Administration.
5. Instruction programs include the Scripps Graduate Department.
6. Director's Office includes the vice chancellor of marine science and his staff, Government Relations, International Relations, and the Center for Earth Observations and Applications.
7. Total development costs are shared between Scripps and UCSD Development.
8. Director's Business Office includes the deputy director of Scripps, administrative staff, and financial staff.
9. Academic and research investments include recruitment funds.
10. Support services includes purchasing, computer systems, safety, dive operations, and Scripps lifeguard.
<table>
<thead>
<tr>
<th>YEAR</th>
<th>PROFESSORS</th>
<th>RESEARCHERS</th>
<th>OTHER ACADEMICS</th>
<th>POSTGRADUATE RESEARCHERS</th>
<th>EMERITUS</th>
<th>CENTRAL ADMIN</th>
<th>COMPUTER/PUBS/ SPEC</th>
<th>ENGINEERS/TECHNICIANS</th>
<th>MARINE SUPPORT</th>
<th>SCIENTIFIC ADMIN</th>
<th>SCIENTIFIC SUPPORT</th>
<th>UNDERGRAD EMPLOYMENT</th>
<th>GRADUATE STUDENTS</th>
<th>VOLUNTEERS &amp; VISITING SCHOLARS</th>
<th>TOTAL</th>
</tr>
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<td>2002</td>
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Support Facilities

Analytical Facility
Bruce Deck

Scientific Collections
Benthic Invertebrates
William A. Newman
Cored Sediments & Dredged Rocks
Richard Norris
Marine Vertebrates
Philip A. Hastings
Pelagic Invertebrates
Mark D. Ohman

Ship Operations and Marine Technical Support

Associate Director
Robert A. Knox

Nimitz Marine Facility

Marine Superintendent
Thomas S. Allhouse
Assistant Marine Superintendent
William L. Krinitski

Masters and Chief Engineers (see Ship Operations Report, page 16)

R/V Roger Revelle, R/V Melville, R/V New Horizon, and R/V Robert C. Shypul

Marine Facility
Shipboard Technical Support Business Office
Joan Durkin

Marine Facility Shop
Joseph Corduan

Shipboard Technical Support
Manager
Woody C. Sutera

Academic Advisor
James H. Swift

Resident Marine Technician Group
Robert C. Wilson

Shipboard Computer Group
Ronald L. Moe & Frank M. Delanoye

Shipboard Electronics Group
Carl W. Mattson

Shipboard Electronics Group
Carl W. Mattson

Shipboard Geophysical Group
Lee Elliott

Oceanographic Data Facility
Kristin M. Sanborn

Marine Science Development Shop
Ken Duff

WOCE Hydrographic Program Office
Stephen C. Diggs

Ship Scheduling and Foreign Clearance
ShipSchedulers
Elizabeth R. Brenner and Rose M. Dufour

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In Memoriam

**February 2005**
Harold “Ted” Hammel died in Bloomington, Indiana, on February 24 at age 83. He was a professor at the Scripps Physiological Research Laboratory from 1967 to 1988. His primary research focus was thermoregulation in animals, including adaptation of humans to extreme climate conditions. His research at Scripps expanded into plant physiology, most notably to osmosis and its function in living systems. Hammel was a junior physicist on the Manhattan Project during World War II. He had a long collaboration with Germany’s Max Planck Institute after being elected an external scientific member in 1978. After leaving Scripps, he remained active in his field as an adjunct professor at the University of Indiana.

**February 2005**
Phillip H. Rapp died in La Jolla on February 24 at the age of 75. He spent 28 years at Scripps as a senior scientific illustrator and communications media specialist, primarily for the Marine Physical Laboratory. He illustrated instruments designed by Scripps scientists and produced artwork and figures for publications. He was also a photographer and videographer. Rapp once drew a giant squid attacking R/P FLIP, which became a familiar image around Scripps. He was active in the Marine Technology Society and served as the San Diego section’s chairman and production editor of its newsletter. He retired from Scripps in 1991.

**March 2005**
R. Nelson Fuller, Scripps’s public affairs officer from 1965 to 1978, died at age 93 on March 22 in Morro Bay, California. He worked as a newspaper editor, edited Rotary International News, served as a wire editor for the Associated Press, and worked in public relations at General Dynamics before his arrival at Scripps. During his busy years at Scripps, he skillfully handled media coverage for distinguished visitors, including Japanese Emperor Hirohito, Vice President Hubert Humphrey, and Vice President Spiro Agnew. In the 1960s, Fuller visited R/V Alpha Helix at the Great Barrier Reef and took a film crew aboard R/V Argo for a leg of the Zetes Expedition off Japan.

**May 2005**
Frederick H. Fisher died in La Jolla on May 4 at age 78. He had been associated with Scripps since 1955. He was a research oceanographer emeritus and the codesigner of FLIP, the Floating Instrument Platform, a stable ocean research platform that has remained in active service for Scripps for more than 40 years. He also led research efforts in underwater acoustics, physical chemistry, ocean technology, and oceanography, and headed a number of Navy-funded research cruises studying long-range propagation of sound in the ocean. After his retirement, he remained an active member of the Scripps Ancient Mariners group and the acoustic research community.

**May 2005**
Angeles Alvarino died on May 29 in La Jolla at age 88. She was an authority on chaetognaths and discovered 22 new species of marine zooplankton. After receiving degrees from the University of Madrid, she taught oceanography, worked for the Spanish Department of Sea Fisheries, studied at Marine Laboratory in Plymouth, England, and was credited with being the first woman to serve as a scientist on a British research vessel. In 1956, she accepted a Fulbright Fellowship for research at Woods Hole Oceanographic Institution, then joined Scripps in 1958. In 1970, Alvarino began pursuing fisheries research with the Southwest Fisheries Science Center, where she worked until her retirement in 1987.

**June 2005**
Charles David Keeling died on June 20 while at his Montana home. He was 77. He was recruited to Scripps in 1956 by then-director Roger Revelle, who had established a research program to monitor carbon dioxide in the atmosphere. Keeling was considered the world’s leading authority on atmospheric greenhouse gas accumulation and a climate science pioneer. He was the first to confirm the rise of atmospheric carbon dioxide by very precise measurements, which produced a data set now known widely as the “Keeling Curve.” Keeling also led major efforts in global carbon cycle modeling. In 2002, President George W. Bush awarded him with the National Medal of Science, and in April 2005, he received the Tyler Prize for Environmental Achievement.
CREDITS

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