*On-line Technology Opens Research World*

# web.science

BY JANET HOWARD

EXPLORATIONS
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On September 25, 1997, during the peak of Hurricane Nora, more than 23,000 people visited Scripps looking for information on how the storms were affecting such things as wave heights along the coast of southern California.

Of course, they didn't all visit the Scripps Center for Coastal Studies. Instead, they accessed a highly popular site on the World Wide Web managed by the Coastal Data Information Program, or CDIP (http://cdip.ucsd.edu/).

"I think this must be one of the most widely accessed scientific sites on the Web," said Ron Flick, an oceanographer at Scripps who is state program manager for CDIP. "We are averaging about 5,000 hits a day and have had 1.7 million hits in the last year."

As people were flocking to CDIP, Flick was busy searching for water and tide-gauge data on a National Oceanic and Atmospheric Administration (NOAA) Web server. Prior to the invention of the Internet, he had to wait over a month to receive such data on tape through the U.S. mail.

"Having access to NOAA's databases has been the biggest deal for me in 20 years because it is so easy and straightforward," Flick said. "Especially compared to what it used to be—a nightmare."

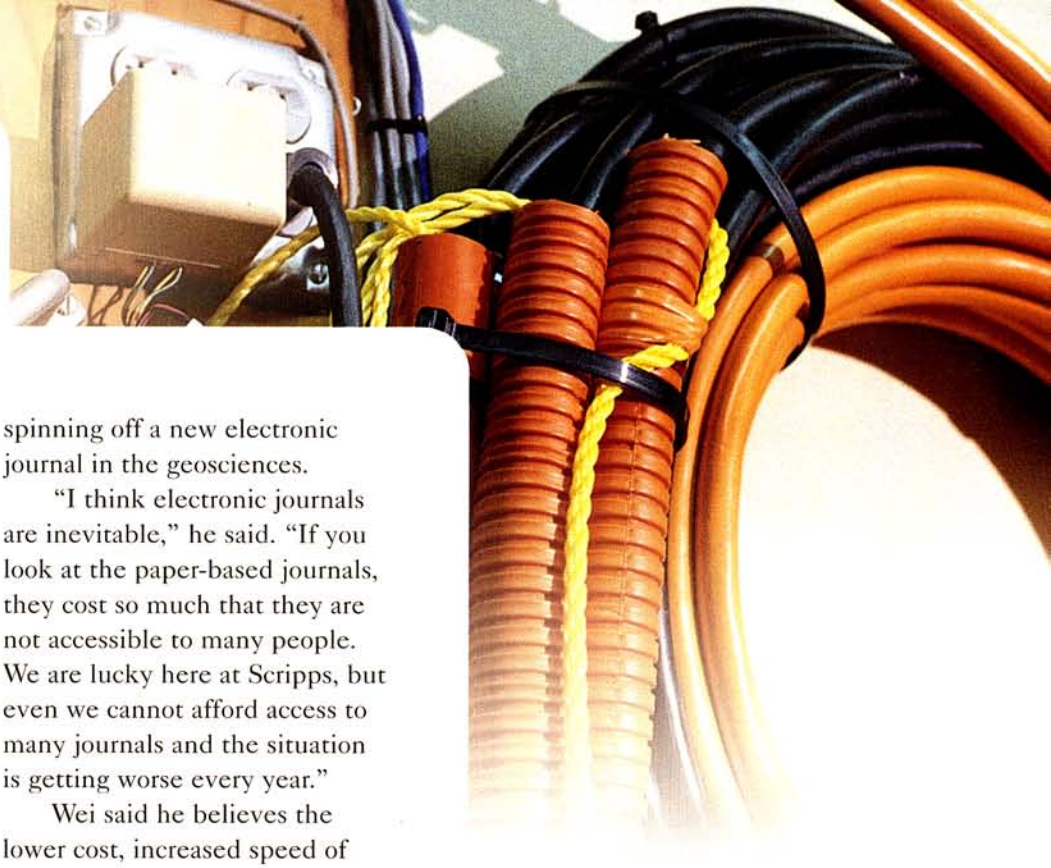
# @scripps

Flick is one of hundreds of researchers at Scripps to whom the Internet has become an essential tool—both for conducting scientific inquiry and for interacting with colleagues and the public at large.

In addition to giving scientists instant access to huge banks of scientific data, the development of the Internet allows researchers to exchange ideas and drafts of scientific papers instantly.

"Nowadays you can collaborate with someone in another hemisphere almost as easily as with someone in another building, so distance is much less relevant," said Wuchang Wei, a geologist in the Geosciences Research Division and curator of the Scripps Geological Collections. "That means you bring experts from the whole world to your surroundings, which changes your potential in terms of what you can achieve."

A true believer in the power of the Internet to change how science is conducted, Wei has developed what he hopes will become the premier geoscience Web site in the world. Called the Geoscience Information Center (http://gs.ucsd.edu), the site features many items not



seen on a typical Web site. Scientists can sit in on a "virtual conference," browse through a "geo-merchandise store" for used lab equipment and books, or download software from the software center. A job center also is available, as are databases for information on national meetings, recently published articles, and other geoscience Web sites. A searchable database of more than 70,000 geoscientists allows researchers to contact colleagues worldwide.

Wei said he came up with the idea for developing the Web site after becoming frustrated with having to spend hours searching the Web looking for information.

"It is becoming more and more difficult to keep up with all the necessary information," he said. "Web sites such as these are badly needed and will become increasingly important in the future."

Wei said he believes the potential of the Web site is enormous for such things as presenting multimedia teaching sessions and research material as well as interactive lectures and conferences. He also hopes to use the Web site as a foundation for spinning off a new electronic journal in the geosciences.

"I think electronic journals are inevitable," he said. "If you look at the paper-based journals, they cost so much that they are not accessible to many people. We are lucky here at Scripps, but even we cannot afford access to many journals and the situation is getting worse every year."

Wei said he believes the lower cost, increased speed of publication, and the interactive aspects of electronic journals make them superior to paper-based journals.

In addition to giving scientists at small institutions access to more scientific journals, Wei said the revolution taking place on the Internet also is beginning to level the scientific playing field by breaking down barriers to collaboration.

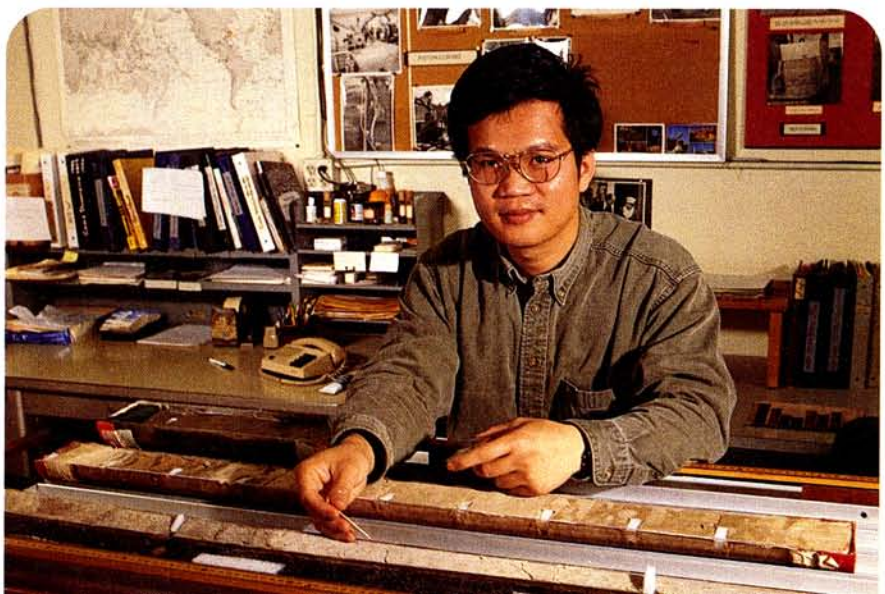
"It definitely has opened things up and given more access to scientists at less prestigious institutions because all of the experts are now within reach," Wei stated.

Lynne Talley, a professor in the Physical Oceanography Research Division, conducts much of her research with a scientist in Alaska. Yet the two scientists rarely meet face to face.

"We do everything by e-mail, including writing proposals," she said.

Indeed, Talley finds that she now spends an average of two to three hours a day communicating with colleagues via e-mail. Like many scientists at Scripps, she





Geologist Wuchang Wei extracts a mud sample from a core stored in the Scripps Geological Collections, of which he is curator. Wei studies nannofossils found in seafloor sediments. Data gathered in the Geological Collections are posted by Wei and colleagues on the Web, as part of an expanding resource for Web users searching for information on the geosciences.

logs onto her computer first thing every morning to check for messages.

Talley also loads much of the data she has collected on cruises such as the World Ocean Circulation Experiment as well as her scientific papers onto a Web site where other researchers can easily access them (http://sam.ucsd.edu/). Last year, she also began loading lecture notes and copies of overheads she uses in her Introduction to Physical Oceanography class onto her home page for use by her students.

Using the Web for teaching is something that is beginning to gain favor with Scripps professors. Students in Lisa Tauxe and David Sandwell's undergraduate earth sciences course, for example, could probably complete much of the course without ever showing up to class. The multilayered Web site includes reading assignments, detailed lecture notes, and handouts. Students also are asked to complete "Web assignments" featuring everything from reading articles by Stephen Hawking to examining graphs showing the mean distances of the Jovian planets from the Sun. Those searching for further information can follow one of numerous links that are provided throughout the site (http://topex.ucsd.edu/es10/es10.html).

Geophysicist Lisa Tauxe is among the professors using the Web as a teaching aid. She is pictured with Marc Argoud, one of her students who is majoring in earth science at UCSD. Tauxe is currently working on a short course in paleomagnetism for publication on the Web.

Tauxe said she and Sandwell first began developing the Web site because they wanted to give students a closer look at what geologists do.

"It's an inexpensive way of leveraging knowledge," she said. "Because of the efforts of other people in putting stuff on the Web, I was able to give students a tour through a mineral collection at the Smithsonian and access to information on ocean drilling."

While Tauxe said she hasn't formally evaluated the success of the site, it appears to be popular with students.

"I know a lot of people hit the site because we put practice midterms on it, and there were so many people accessing the site at once that the computer almost crashed," she said.

As it turns out, Tauxe and Sandwell's efforts haven't done anything to dissuade students from coming to class.

"I found that our attendance was actually much higher than it had been previously," said Tauxe. "Of course, it may just be that they like my jokes."

Some Scripps faculty also are designing their own Web pages that can encompass everything from abstracts of scientific papers to copies of their wedding pictures.

Peter Franks, a biological oceanographer in the Scripps Marine Life Research Group, said he finds his Web page (http://spiff.ucsd.edu/) useful for communicating with prospective graduate students about his various research projects.

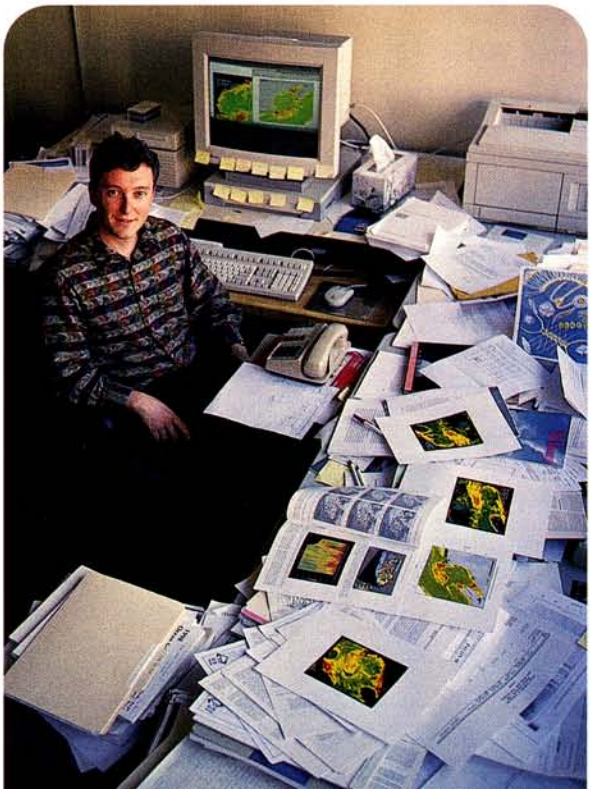
"I've had a lot of graduate students saying they would like to come and work with me, and they really don't have a clue as to what I am doing," said Franks. "Now, I refer them to my Web page and they are able to ask more educated questions."

Franks, a contributing editor to a new electronic journal on animated computer models, also loads many computerized animations of scientific figures onto his Web site. He then notes the Web address in his scientific publications, referring readers to accompanying animated models.

Like many scientists, Franks believes that the biggest advantage to the Internet is that it allows for instant communication.

"It's easy for me to quickly talk to a bunch of experts in the field in a relatively informal way," said Franks, who collaborates on projects with scientists across the country. "I don't have to call a meeting; I don't have to send them a handwritten letter. I can just pop them an e-mail and ask them, 'Would you mind loading up this Web page and looking at this animation?'"

Franks's page also includes items for people looking for something a little on the lighter side. One link, for example, takes visitors to a photo of a wetsuit-clad Franks aboard his windsurfer. The picture was featured in a 1996 "Studmuffins of Science" calendar—Franks was chosen as "Dr. November."



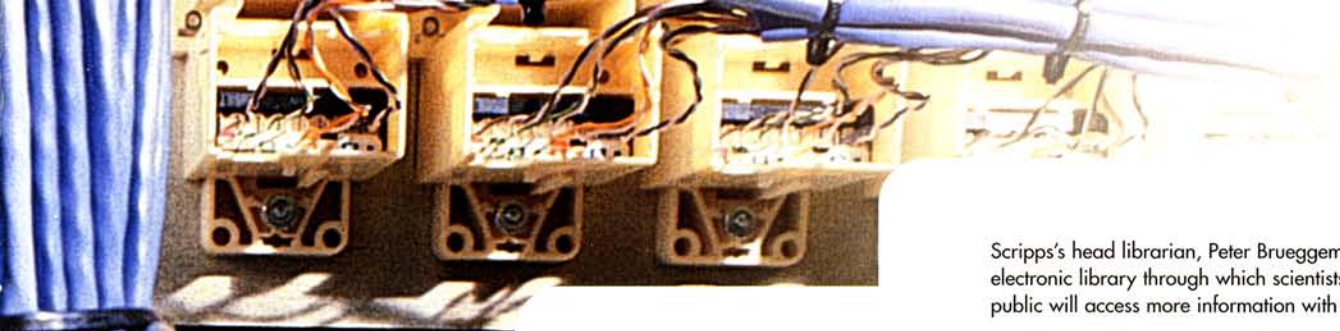
A strong proponent of the use of electronic media in communicating science to the public, biological oceanographer Peter Franks maintains a Web site where he posts computerized animations of results from his research.

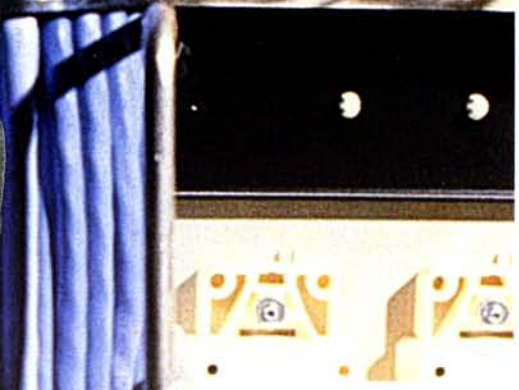
Those interested in the bioluminescence often seen in conjunction with a red tide should visit a home page hosted by marine biologist Michael Latz (http://siolib-155.ucsd.edu/mlatz/Biolum_intro.html). In addition to explaining red tides, Latz gives instruction on how to put on your own light show using tiny bioluminescent organisms called dinoflagellates and provides links to more sites.

Scripps climatologist Larry Riddle hosts a site that features current and past weather information (http://meteora.ucsd.edu/weather.html). Riddle, known as the Scripps "weather man," developed the site because he wanted to present weather data in an understandable and intriguing way to students and teachers.

"I've taught classes myself in the past and found that there just aren't many resources out there," said Riddle.

The page, which is targeted to students in kindergarten through high school, features real-time weather observations from around the globe. Data available include worldwide sea-





surface temperatures, storm and weather warnings from the National Weather Service, earthquake reports, and weather forecasts. Data collected from the end of the Scripps Pier since 1916, including weather conditions, wind speed, and humidity, also are available.

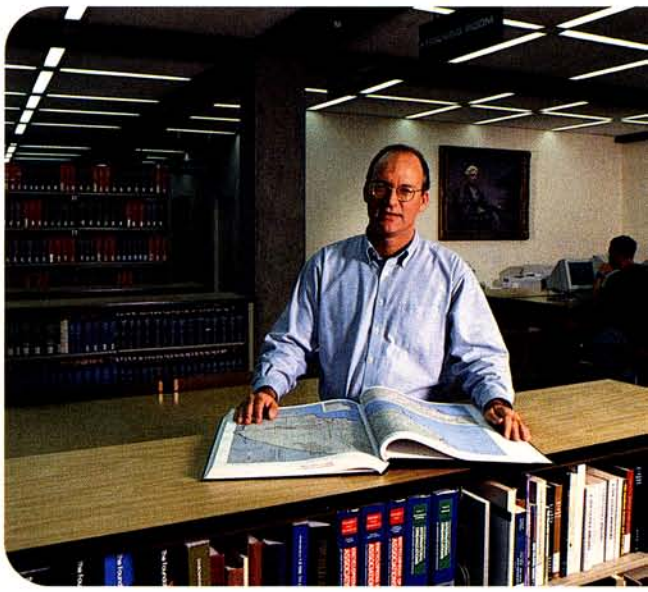
Those interested in real-time data on coastal conditions soon will be able to use the Internet to link to a new marine observatory deployed off the coast of La Jolla in November 1997. The buoy, one of two stationed west of the La Jolla coast by Scripps, will provide the latest air temperature, water temperature, wind speed, wind direction, surface wave data, and humidity readings, said David Rogers, chief scientist for the project. Dedicated Web pages will allow scientists to have direct access to real-time data from the 33-foot (10 m) buoys and give them the capability to change instrument settings and perform calibrations from a remote location. Rogers envisions that in the future large networks of platforms will be linked via the Web to provide real-time maps of data on such things as regional water quality, sea-surface temperature, and wind speed. This Web site should be available soon.

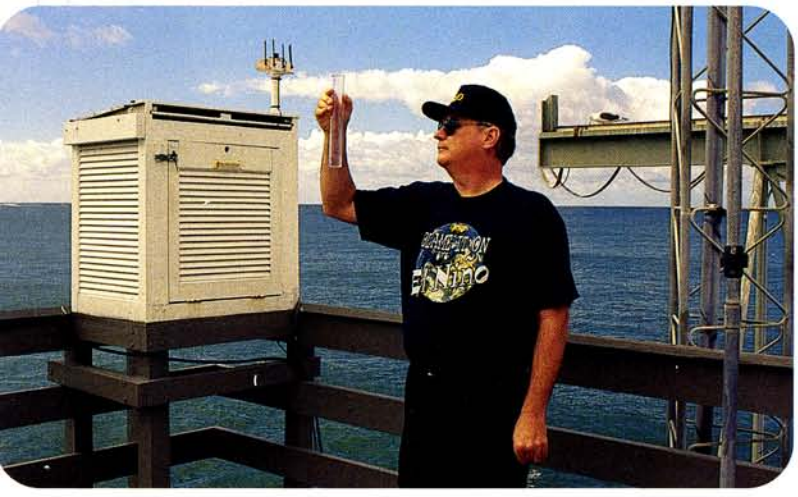
The Scripps Library Web page (http://sio.ucsd.edu/loc_services/) is a must-see for anyone conducting research in the marine sciences. Electronic indexes now allow scientists to search for research articles by subject, title, or author and provide instant access to abstracts summarizing the articles. In some cases, the full text of the article is available.

Instead of browsing the stacks, many scientists now come to the library only to photocopy articles they have found through online services, said Scripps librarian Peter Brueggeman. The library also allows researchers to set up automatic weekly e-mails alerting them to the latest articles appearing on topics they have selected.

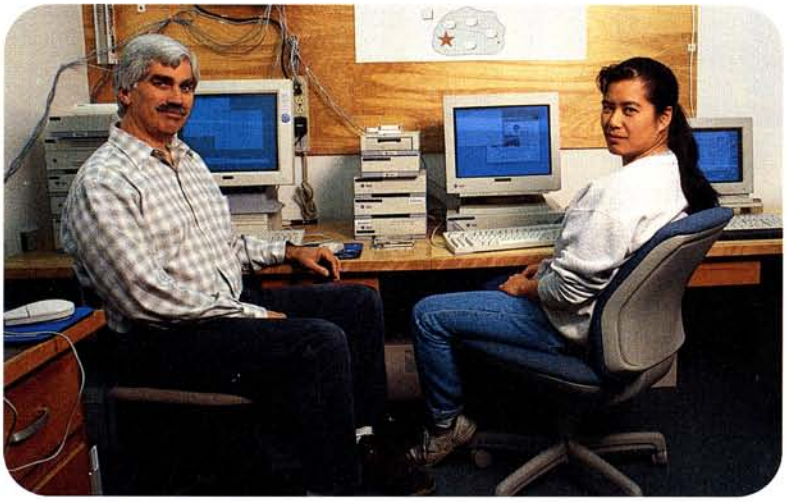
"Because of the Internet, scientists certainly have much better tools now for keeping up with the literature and finding out what has been published in their field," said Brueggeman.

Scripps's head librarian, Peter Brueggeman, foresees an electronic library through which scientists and the general public will access more information with greater speed.





Larry "The Weather Man" Riddle checks the measuring tube from a manual rain gauge, part of a mini weather station near the end of Scripps Pier. Information gathered by Riddle and others is posted on his Web site, which includes current and historical weather data and forecasts, along with atmospheric, oceanographic, and seismographic updates.



Mick Laver, manager of administrative systems and networking, and computer specialist Karin Fong are among those responsible for maintaining the vast computer networks at Scripps.

That trend should continue to improve thanks to a new effort by the University of California to expand access to professional journals and other materials available on-line. UC librarians also are hoping the university will begin to publish more of its own electronic professional journals in order to help cut costs.

The average cost of professional journals increases by about 10 to 12 percent a year, said Brueggeman. With library funding remaining relatively flat, that means Brueggeman must lament each year over which research journals to cut.

"If scholarly societies and universities would start taking over the reins of journal publishing and start putting out electronic journals for free or at ultra-low cost, that would change things," said Brueggeman. "The problem is it takes money."

The move toward an electronic library is only one of the changes that university researchers will see as the Internet moves into the next century.

Mick Laver, manager of administrative systems and networking at Scripps, predicts that scientists soon will routinely transmit voice and video images on the Internet. The biggest change, however, is going to be a quantum jump in the speed at which information is sent, paving the way for researchers to exchange gigantic files of data that previously would have slowed networks to a crawl.

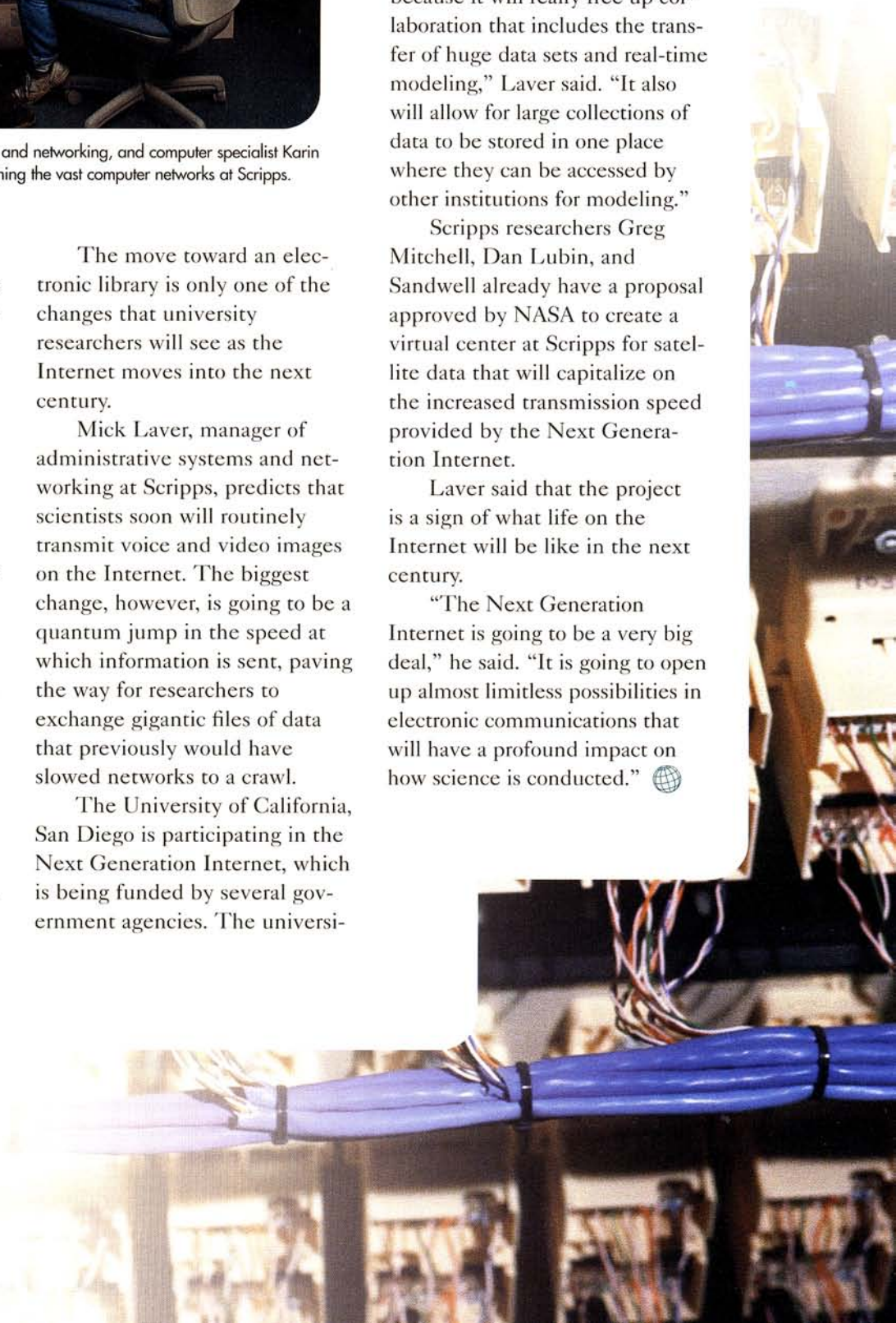
The University of California, San Diego is participating in the Next Generation Internet, which is being funded by several government agencies. The university is one of 10 institutions marked to receive "backbone connections" that are 1000 times faster than the current speed, Laver said. An additional 100 institutions will be provided connections at 100 times their current speed.

"This will have a big impact because it will really free up collaboration that includes the transfer of huge data sets and real-time modeling," Laver said. "It also will allow for large collections of data to be stored in one place where they can be accessed by other institutions for modeling."

Scripps researchers Greg Mitchell, Dan Lubin, and Sandwell already have a proposal approved by NASA to create a virtual center at Scripps for satellite data that will capitalize on the increased transmission speed provided by the Next Generation Internet.

Laver said that the project is a sign of what life on the Internet will be like in the next century.

"The Next Generation Internet is going to be a very big deal," he said. "It is going to open up almost limitless possibilities in electronic communications that will have a profound impact on how science is conducted."



# Scripps on the Web

Looking for information on El Niño?
The Birch Aquarium at Scripps?

*The following represent a smorgasbord of some interesting Web sites at Scripps. Many of these sites can be accessed through the main Scripps home page (http://sio.ucsd.edu).*

### Birch Aquarium at Scripps
http://www-aquarium.ucsd.edu/

Information on activities, educational programs, member services, and special exhibits at the Birch Aquarium

### Campus Tour
Accessed through http://sio.ucsd.edu/pubreach.html

A virtual campus tour of Scripps and the Birch Aquarium

### Coastal Data Information Program (CDIP)
http://cdip.ucsd.edu/

Information about coastal conditions such as wind, wave, and temperature measurements

### Climate Research Division
http://meteora.ucsd.edu/

Information on weather and El Niño research and predictions, the Scripps Experimental Climate Prediction Center, and the International Research Institute for climate prediction (IRI)

### El Niño Information
Accessed through http://sio.ucsd.edu/pubreach.html

A comprehensive list of key El Niño web sites

### Library
http://sio.ucsd.edu/loc_services/

Links researchers to a wide variety of electronic databases, texts, and periodicals and links to other oceanographic and earth science institutions

### Pier Camera
http://sio.ucsd.edu/piershot.html

Regularly updated pictures of La Jolla Shores Beach

### Scripps Photographic Archives
http://scilib.ucsd.edu/sio/archives/photos/

Holds dozens of photographs chronicling the institution

### Teaching Staff at Scripps
http://www-siograddept.ucsd.edu/Web/sioteachingstaff.html

Provides links to Scripps faculty