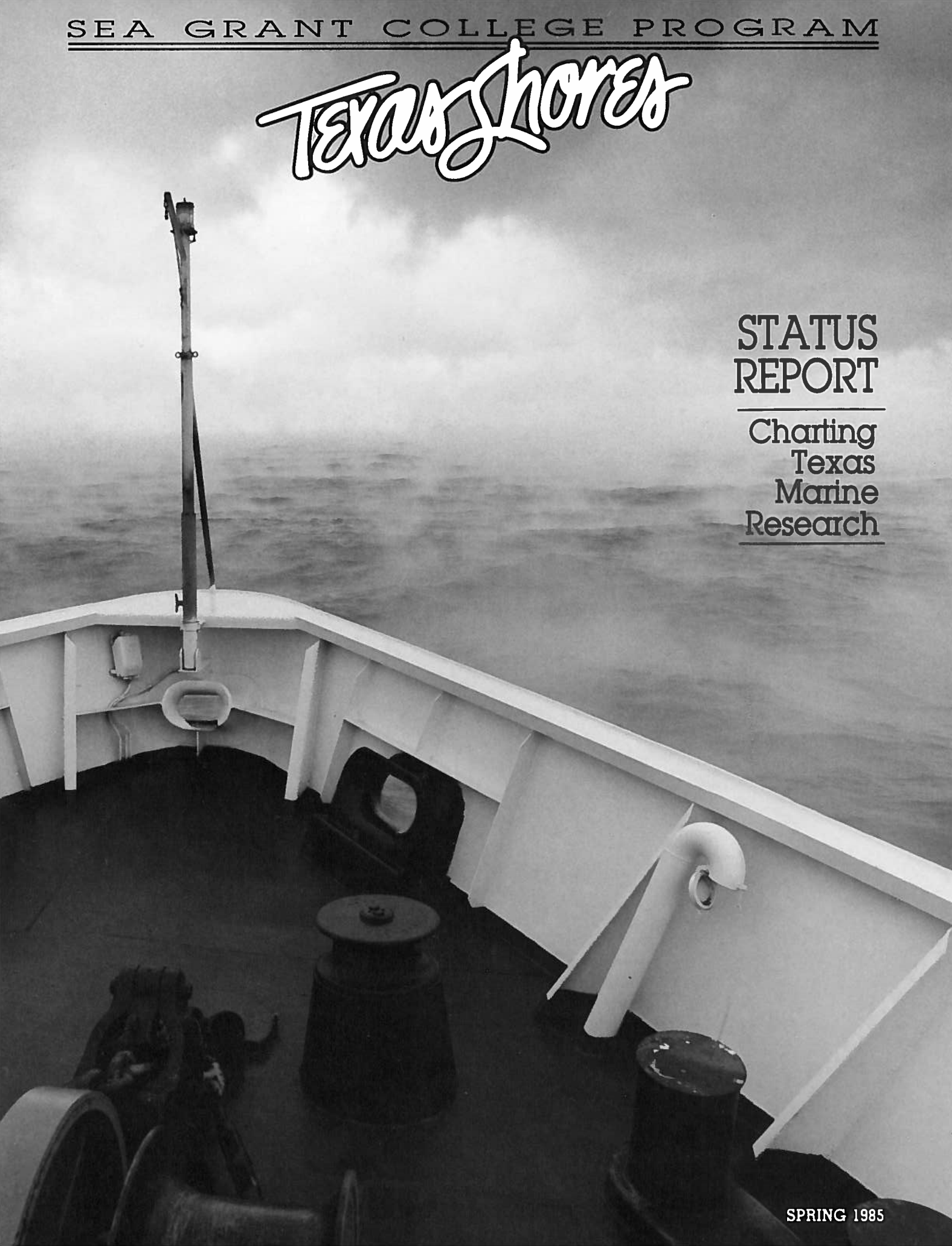
SEA GRANT COLLEGE PROGRAM

Texas Shores



STATUS REPORT

Charting Texas Marine Research

SPRING 1985

The Science of Sea Grant.

It's been fifteen years since Texas A&M University was designated a Sea Grant College by the U.S. Secretary of Commerce. In that time we have developed a major marine research program that addresses the scientific questions important to our use of the marine environment. Moreover, it has brought to bear the expertise of economists, lawyers and historians, as well as political scientists, sociologists and marketing professors on marine issues.

This new flow of thought from outside the traditional boundaries of marine science has permitted Sea Grant to focus on many important questions never seriously considered previously. These professionals have helped interpret basic marine research in ways important to those directly concerned with the use and welfare of the oceans and their borders.

Sea Grant is a sound investment of public funds. That fact has been recognized repeatedly by the Texas Legislature, Governor's Office, members of Congress, educators, business people and citizens' groups.

We believe short-term budget concerns must not be allowed to diminish our commitment to the understanding and wise use of our marine and coastal resources.

Sea Grant. Solutions Through Research

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Volume 18 Number 1

Texas Shores

Despite a tradition steeped in cowboy legend, Texas is breaking ground in new frontiers far from the open plains. This time the frontier is the sea and Texas is taking the forefront in developing marine science programs that make important contributions to the world of science and, ultimately, add to the well-being of people everywhere. The essential element in this quest is research and development. While development lies primarily with the private sector, the research duties are being carried out in individual projects of breathtaking scope. To support much of this sea science, Texas has one of the largest research vessel fleets in the nation. The cover photograph from the bow of the JOIDES Resolution was taken by John Beck.

Texas Shores is published quarterly by the Sea Grant College Program at Texas A&M University in an effort to promote a better understanding of the Texas marine environment.

Feenan D. Jennings, *Texas A&M Sea Grant Director;* Norman Martin and Laura Colunga, *Editors;* Celia Jeter, *Art Director,*

Sea Grant is a partnership of university, government and industry focusing on marine research, education and advisory service. Nationally, Sea Grant began in 1966 with the passage of the Sea Grant Program and College Act. Patterned after the Land Grant Act of the 1860s, the Sea Grant concept is a practical, broad-based scientific effort to better the world for all those living in and out of the sea.

In 1968 Texas A&M received the distinction of being named among the nation's first six institutional award recipients. Three years later the school was designated a Sea Grant College. The university has a rich heritage of oceanography research dating back to 1949 when the program began. In addition there is an on-going program to get marine information to the public.

The effort is aided by seven county marine extension agents serving the nine coastal counties of Texas. These individuals are backed by a group of specialists in marine recreation, fisheries and business management, as well as sea food marketing and consumer education.

Sea Grant is a matching funds program. The Texas A&M Sea Grant College Program itself is made possible through an institutional award from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce, and appropriations from the Texas Legislature and local governments.

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MARINE ADVISOR

BY DOTTY CURTSINGER

Marine/Offshore meeting scheduled for Houston

Representatives from leading marine and offshore industries will discuss business trends and developments over the next three years in a one-day Marine/Offshore Industry Outlook Conference, Thursday, April 18, at the Hobby Airport Hilton Hotel in Houston.

Conference sessions will bring participants up to date on developments and problems which industry leaders anticipate between now and 1987, according to coordinator Dewayne Hollin, business management specialist with the Texas A&M Marine Advisory Service.

Registration for the conference is $40, which includes seminar materials and a luncheon. For registration information, write: Outlook Conference, Sea Grant College Program, Texas A&M University, College Station, Texas, 77843-4115, or call (409) 845-3854.

The conference is cosponsored by Sea Grant and the Marine Services Association of Texas, an organization of marine supply services and businesses.

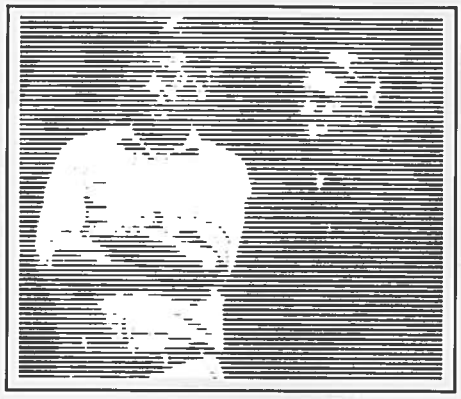
Bisulfite level studied by Sea Grant researcher

Based on the findings of a Texas A&M Sea Grant researcher, the U.S. Food and Drug Administration has raised the ceiling on the safe use of sodium bisulfite on Gulf of Mexico shrimp catches.

Sodium bisulfite, known in the industry as shrimp powder, is commonly used to prevent black spot in shrimp, a discoloration that doesn't affect quality but reduces market value.

The powder is widely used for its color-preserving qualities in many other food products, including saladbar lettuce, pre-cut potatoes, beer and wine.

The chemical recently came under FDA and public scrutiny after being linked with severe allergic reactions and in some cases the death of people



eating food treated with the it.

Dr. Gunnar Finne, a Texas A&M seafood technologist, was commissioned by the National Fisheries Institute to resolve apparent contradictions in the legal use of sodium bisulfite on shrimp.

Until recently, the FDA limited sodium bisulfite residue levels to 40 parts per million, and was confiscating any shrimp shipments found to exceed that limit. However, an effective treatment mandates a one-minute dipping in a 1.25 percent sodium bisulfite solution, which brings residue levels up to 75 to 100 ppm, Finne said.

Data from his experiments has convinced the FDA that the ceiling on sodium bisulfite levels can be safely raised to 100 ppm on shrimp, a move that will free up numerous impounded shipments of frozen shrimp.

The FDA is expected to promote additional rulemaking on the use of sulfites though, as it reviews the status of sodium bisulfite as a possible health hazard for certain segments of the population suffering from asthma.

Donations boost state's marine research funding

Recent contributions from private individuals and conservation organizations will go a long way toward furthering marine fisheries and wetlands research in Texas.

The Texas Parks and Wildlife Department accepted checks from five contributors totaling $120,000 for the construction of a new laboratory at the Department's Marine Fishery Research Station in Palacios.

The building will more than double current space for experimental spawning and rearing of game fish, according to the Department, and allow for expansion of the spotted seatrout, flounder, striped bass and redfish/black drum hybrid programs.

Contributors and amounts provided are: Perry R. Bass, Fort Worth, $60,000; W.B. Osborn Jr., Santa Elena, $10,000; George Hixon, San Antonio, $5,000; the Gulf Coast Conservation Association, $35,000; and Zebco's Fish America Foundation, $10,000.

The Houston Safari Club has donated $10,000 to the Department to be used for wetland research in Jefferson County. The money will help the department pay its share of the cost of a three-year (1984-86) research project in the Salt Bayou Basin.

Tip service continues to trap game thieves

If you suspect someone of violating game and fish laws, you can anonymously report the violator to proper authorities and perhaps receive a monetary reward.

It's possible through Operation Game Thief, a project of the Texas Department of Parks and Wildlife that has just completed its third successful year.

Tips can be reported by calling toll-free 1-800-792-GAME, and if they lead to convictions, callers receive cash rewards.

Callers are assured of complete anonymity but at the same time provide information needed by game wardens to better enforce the state's game laws.

To date, more than 2,400 calls have been received, the Department reports. Of these, 255 resulted in 532 arrests and 916 convictions. A total of $114,704 in fines have been collected.

Insurance costs squeeze Texas commercial fleet

Inability to procure insurance may keep hundreds of commercial fishing vessels tied up this year, a situation that is already reaching crisis level in at least one Texas port.

Cameron County marine agent Tony Reisinger says 70 boats in the Brownsville-Port Isabel shrimp fleet of about 400 are presently unable to obtain or afford protection and indemnity (P&I) insurance. P&I insurance costs have skyrocketed as major marine insurance carriers attempt to recover from a growing number of injury claims filed against boatowners.

Some assistance may come from Washington. Key members of Congress have begun investigating the insurance problems facing the U.S. fishing industry. Congressman John Breaux (D-La.), chairman of the House Subcommittee on Fisheries, has announced intentions to conduct fact-finding hearings in Boston, New Orleans and Washington.

According to a spokesman for Breaux, results from these hearings will be compiled and if necessary, legislation will be introduced to alleviate the insurance burden.

Non-toxic paint additive available to boat owners

Ship and boatowners thought their marine fouling problems were solved with the introduction of antifoulant paints in the early 60s. By and large, they have been.

The protective paints have either stopped or significantly reduced the accumulation of barnacles and other tiny marine organisms on boat bottoms, which translates into significant savings on fuel and speed.

Today's antifoulants, however, release toxic materials which affect both marine and human life, according to Dr. Ralph Grams, a Florida physician who recently announced formulation of an "environmentally attractive" alternative.

It is a paint additive that Grams says is the only non-toxic material the Environmental Protection Agency has registered as an antifoulant.

The additive, on the market just this year, is being sold under the name "Compound X." Its active ingredients attack those factors which specifically promote underwater fouling, then self-destruct to basic biodegradable elements 12 to 24 hours after leaching from the treated surface, Grams said.

Grams stressed that his formula is still an additive, not a replacement for antifoulant paints. "On the horizon is the possibility of combining our material with some of the non-toxic bottom paints that are currently on the market," he said.

Government will resume seizing illegal catches

The National Marine Fisheries Service has announced it will resume to-the-letter enforcement of the Lacey Act as it pertains to U.S. shrimping vessels illegally fishing in Mexican waters.

The Lacey Act provides for U.S. enforcement of penalties against any American vessel violating a foreign law. Shrimpers have been subject to fines and seizure of catches if caught fishing in Mexican waters without proper licenses.

For much of last year, while members of Congress eyed an amendment exempting shrimping from Lacey Act provisions, shrimpers suspected of violating the law were fined but allowed to keep their catch.

That amendment eventually died in committee, but the Coast Guard and NMFS agents have begun informing shrimp boat captains they will resume seizing catches.

A NMFS spokesman said all documented seizures to date have been from Texas ports. According to Cameron County marine agent Tony Reisinger, 400 citations representing more than $4 million in potential fines have been issued to Brownsville-Port Isabel shrimpers alone.

Late last year, the Mexican government advised the U.S. Embassy in Mexico City that it is considering greatly increasing fines for illegal shrimping.

Shrimp tagging program studies migration path

A special shrimp tagging study this summer should give biologists and resource managers some idea of how many shrimp migrate from Texas waters into Mexican waters during the period shrimping is off-limits in Texas.

According to Neal Baxter, a biologist with the National Marine Fisheries Services and director of the study, approximately 100,000 tagged shrimp will be released from three locations in Texas and 20,000 from a bay in Mexico some time in late June or early July.

"The results of the study should give us some idea if shrimp are lost to Mexico during the Texas Closure," Baxter said.

Baxter said those who return tags from captured shrimp will be eligible for cash prizes of up to $500. Mexico has also agreed to participate in both tagging and recovery of shrimp in Mexican waters.

Congress has provided special funding through the Gulf of Mexico Fisheries Management Council for the transboundary study. The project came about at the request of the Texas Shrimp Association, a private organization of the state's shrimping interests.

Free sail line fishing guide offered by state

The Texas Parks and Wildlife Department is offering a free leaflet on how to construct and operate a sail line, an innovative form a fishing that gives coastal bank fishermen the ability to fish in fairly distant water without the aid of a boat, pier or jetty.

The guide is authored by TPWD biologist Hal Osburn, who says sail line anglers can take advantage of offshore breezes by attaching their line to a small sail supported on a raft.

Since sail lines are actually a type of trotline, they are subject to certain regulations, the Department reminds.

To obtain the leaflet, write the Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas, 78744.

FULL SPEED AHEAD

TEXAS MARINE RESEARCH

Texas is a big fish in the sea of marine research. In fact, many observers see the state fast becoming a center for some of the most varied and exciting ventures in the world of ocean science.

For instance, Texas got a tremendous boost to international prominence last year when Texas A&M University was able to pull in one of biggest National Science Foundation marine contracts of the century. The land-locked university was the choice to become the world's center for the scientific study of ocean drilling. The $255 million project includes a huge deep-sea drilling ship that can drill in water depths up to 27,000 feet.

The scope of the scientific efforts goes well beyond the boundaries of the Gulf of Mexico. Texans can be found sailing the icy waters of the Antarctic seas tracing frigid ocean currents. Others glide beneath the waves off Turkey, unearthing Bronze Age sailing ships as part of the world's leading nautical archaeology team.

Still other marine research teams, such as the one at the University of Texas Medical Branch at Galveston, probe the brain lobes of octopuses in search of answers to how the human brain learns. There are environmental issues being addressed, too. A group of marine engineers at Texas A&M concentrates on oil spill assessment and clean-up, while another scientific team studies ways to rebuild populations of ancient, endangered sea turtles on the Texas coast.

Then, of course, there is the essential gastronomic element of research so close to the hearts and stomachs of the state's residents — producing more and better seafood. One marine scientist near Corpus Christi is well on the way to developing a base for a budding commercial shrimp farming industry.

Naturally, not every marine project can be detailed, but here are the half-time highlights, if you will, of a variety of projects currently underway in the state.

BY NORMAN MARTIN

Donald Frey

Texas A&M archaeologists uncover hull remains of an 11th century shipwreck.

WAY DOWN DEEP

Topping the Texas list of marine projects is Texas A&M's Ocean Drilling Project. The school is the scientific manager of the 10-year project that will involve a series of worldwide coring expeditions to learn more about the Earth's crust, mineral formations and global weather effects.

"This is the crown jewel of American earth sciences," says Dr. William Merrell, associate dean of the College of Geosciences at Texas A&M and principal investigator for the Ocean Drilling Program. "There won't be an encyclopedia written in the next 10 years that doesn't mention this program and Texas A&M in it."

The multi-million dollar international Ocean Drilling Program is funded by the National Science Foundation and managed by Texas A&M. The program replaces the NSF's *Glomar Challenger* expeditions, which for 15 years toured the seas gathering core samples and other data from holes drilled 13,000 feet into the earth. The Challenger's program ended in the fall of 1983.

Texas A&M will manage a drilling ship, the 470-foot *JOIDES Resolution*, for the project, as well as organize the research activities. It will also build a $5 million laboratory and storage facility on the Texas A&M campus for the core samples and project staff.

JOIDES, short for Joint Oceanographic Institutions for Deep Earth Sampling, is a consortium of 10 universities and participating foreign nations that keep the huge scientific program on track.

Areas from around the globe will be studied, including the Arctic and Antarctic circles, the Mediterranean Sea and the Pacific coast of South America. For the ship's first year at sea, six sites have been scheduled. They are the Gulf of Mexico, Bahamas, Barbados area, Labrador Sea, Norwegian Sea and mid-Atlantic ridge.

After core samples are drawn by the drill ship, they will be stored at three sites in the United States. Researchers will analyze their age and composition. The ship will be able to get other kinds of data at the drill site by "logging" the holes, or inserting instruments to measure the crust's density, temperature, magnetic charge and porosity. The logged holes will be capped with sonar receptive cones so that the ship can return and retrieve the instruments and their data months or years later.

Texas A&M is constructing a new building on campus to provide refrigerated storage for many of the core samples. Each core will be sliced in half lengthwise, Merrell says; half will go into the archives, while the other half is sampled and studied.

The facility will make College Station the international center for earth science study, says project director.

"We have a series of scientific objectives," Merrell adds. "We're going to investigate the concept of plate tectonics in an effort to understand the dynamic Earth and the concepts of seafloor spreading."

John Beck

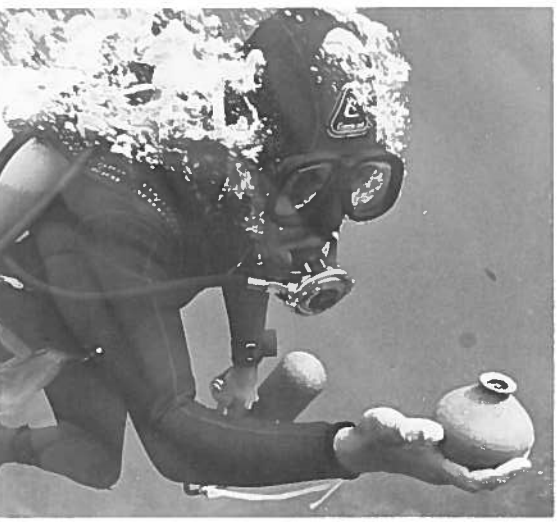
Helicopters (top) are used to ferry crew changes to the drillship, JOIDES Resolution. Scientists test new ocean drilling equipment (above, right), while staff members retrieve a 30-foot core from the drillship's core barrel (above, left).

BRONZE AGE BEAUTY

Another sector of the Texas marine science community concentrates on ancient seafaring civilizations.

In December, Texas A&M marine archeologist Dr. George Bass stunned the world when he announced the discovery of a 3,400-year-old ship off the coast of southern Turkey, a Bronze Age vessel which sank before the Trojan War. Bass and his colleagues spent years searching for such a vessel, guided not by sonar and underwater television, but by interviews with Turkish sponge divers.

The discovery, partially funded by the National Geographic Society, has been described as the most extensive collection of Bronze Age artifacts ever



Donald Frey

Texas A&M Institute of Nautical Archaeology researchers (top) carry wooden hull fragments to the surface. A student (above, left) retrieves a 2,000-year-old jar from a shipwreck in Turkey. One recovered glass tumbler (above, right) has been dated about 1025 A.D..

found underneath the sea. The cargo ship, which lies 170 feet beneath the Mediterranean, carried gold goblets, glass ingots, copper and tin — even an elephant tusk. Anthropologists believe the ship set sail from Syria for Greece or Turkey in 1400 B.C. at about the time of King Tut.

But the discovery didn't really come as a surprise to those who know Bass. Many scholars and archeologists across the world regard him as the father of modern nautical archeology. And the Institute of Nautical Archeology, based at Texas A&M since 1976, is considered the premier American research group in the field.

Bass explains that the business of nautical archeology concentrates on ships. And since ships were the main mode of war, commerce, transportation and exploration until the 19th century, shipwrecks are time capsules of the periods from which they date. By studying the relics obtained at these sites, historians and scientists can piece together a better picture of these civilizations, he says.

Researchers at the institute have assisted in the recovery of more than two dozen shipwrecks and related projects on four continents.

In the late 1970s the institute staff excavated another rich find off the Turkish coast — the Glass Wreck, a Medieval merchantman dated to around 1025. It has become the largest single source of medieval glass in the world, yielding bowls, pitchers and tumblers engraved with Picasso-esque lions. But the ship is also giving scientists a look at one of the first vessels constructed with modern building techniques.

Meanwhile, work by the Texas A&M nautical archeologists is slowly unlocking a time capsule of 17th century British colonial life from the sunken homes and shops of Port Royal, Jamaica. These days, Port Royal is a fishing village at the mouth of Kingston Harbor. In 1692, it was known at the wickedest city in Christendom, a notorious haven for pirates who preyed on ships bearing riches home from the New World. An earthquake struck and two thirds of Port Royal sank into the Caribbean where a slice of civilization was preserved instantly.

The institute also has advised the Canadian government on raising two American ships sunk in Lake Ontario during the War of 1812.

As for their latest discovery, Bass says they found gold jewlery, beads of amber, earthenware, an elephant tusk and a hippopotamus tooth from three Bronze Age civilizations — the Canaanite, Mycenaean-Greek and Cypriot. "What we have is an enormous cargo of raw materials," Bass says. The heaviest objects found at the site were eight stone anchors, each weighing from 600 to 800 pounds.

The excavations of the Texas A&M team have set underwater archeology on solid footing in the world of science, he says. Part of Bass' reputation comes from the techniques he has developed, many of which are now standard at underwater excavations around the world.

For instance, Bass maps and photographs each shipwreck with stereophotographs, using a system he developed 20 years ago. With that information, scientists can study the placement of the items and surviving chunks of the hull to determine the ship's dimensions.

In addition, Bass's team invented new equipment for excavations, including an underwater phone system so that divers can communicate while working, and a submersible decompression chamber.

But diving is only a small part of the work of nautical archeologists. "We average two years on conservation, recording and research for every month we dive — and not even all our staff and students dive," Bass says.

FOOD FOR THOUGHT

There are other exciting twists to Texas-style marine research. For instance, marine scientists at the University of Texas Medical Branch are on the verge of major breakthroughs in growing the octopus for research and commercial use.

More than 30 years of investigation have gone into describing the structure and function of the octopus brain, says Dr. Roger Hanlon, chief of the medical branch's Marine Biomedical Institute division of biology and marine resources.

"It's a very complex organ, and the octopus is perhaps better adapted to its environemnt than even man is to his," he says.

Though no scientist claims that work with octopuses translates directly into knowledge of humans, Hanlon says there are similarities in brain function. Both octopuses and humans have short- and long-term memory.

What is more important is the model the octupus provides for examining the process of learning. An octopus' brain lobes have discrete, specialized functions. As a result, the animal can be tested to determine which aspects of memory and learning have been altered after surgical removal of a specific lobe.

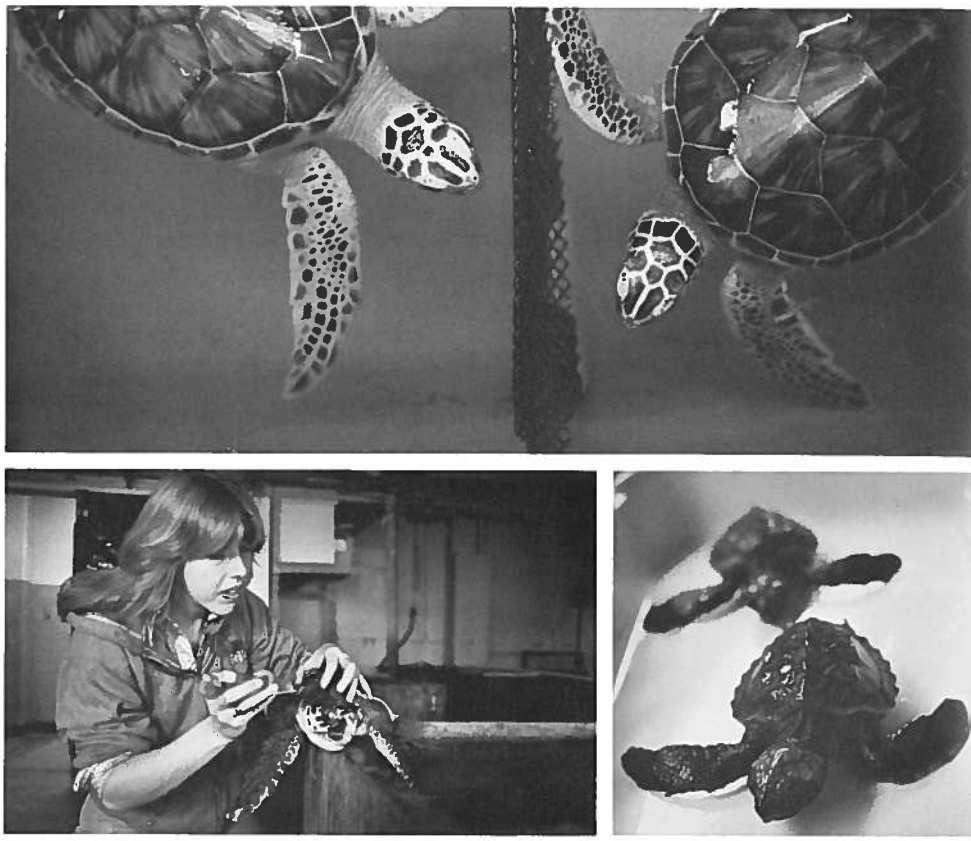
The octopus brain with its 66 lobes is one of the best-known brains in the animal kingdom from a research standpoint. Hanlon says their studies indicate that the *Octopus bimaculoides* is the best candidate among five octopus species studied for culture potential under laboratory conditions.

The work is being carried out under the cephalopod mariculture program at the institute.

While many scientists have chosen simpler animals to study the source and site of learning, Hanlon believes the octopus still has a major research role. "Once the basic facts are learned from simplier forms, the octopus will regain its stature as a research animal and we will be ready as a source of supply when that happens," Hanlon says.

There's another reason for studying the octopus, Hanlon says. It has tremendous potential in food production.

Contrary to its horror movie typecasting, the octopus is a food delicacy in many parts of the world. Octopus meat is sweet, nutritious and tender if cooked properly.



Norman Martin

Two green turtles (top) pass each other in holding tanks at Texas A&M University. A blood sample is taken (above, left) from a Loggerhead Sea Turtle. These six-month-old baby sea turtles (above, right) will one day weigh more than 300 pounds.

Because it is a food source in much of the world, there is a growing interest in raising octopus in captivity for commercial use. Now, the only large scale harvesting of octopuses is in Japan, the western coast of Africa and in limited areas in the Mediterranean Sea and near Mexico's Yucatan Peninsula. The university's work in growing octopuses commercially has been in conjunction with the Mexican Department of Fisheries.

Hanlon emaphsizes that commercial culturing is trickier than growing the animals for laboratory use. Since the mature octopus lays eggs only once a year, the researchers must learn to alter the life cycle to produce eggs whenever they are needed. That involves manipulating temperature and light intensity to alter the animal's breeding habits.

"We can grow the animals through their life cycle in the laboratory on a large-scale pilot basis, Hanlon says. "Now we need to do the fine tuning involved in reducing cost."

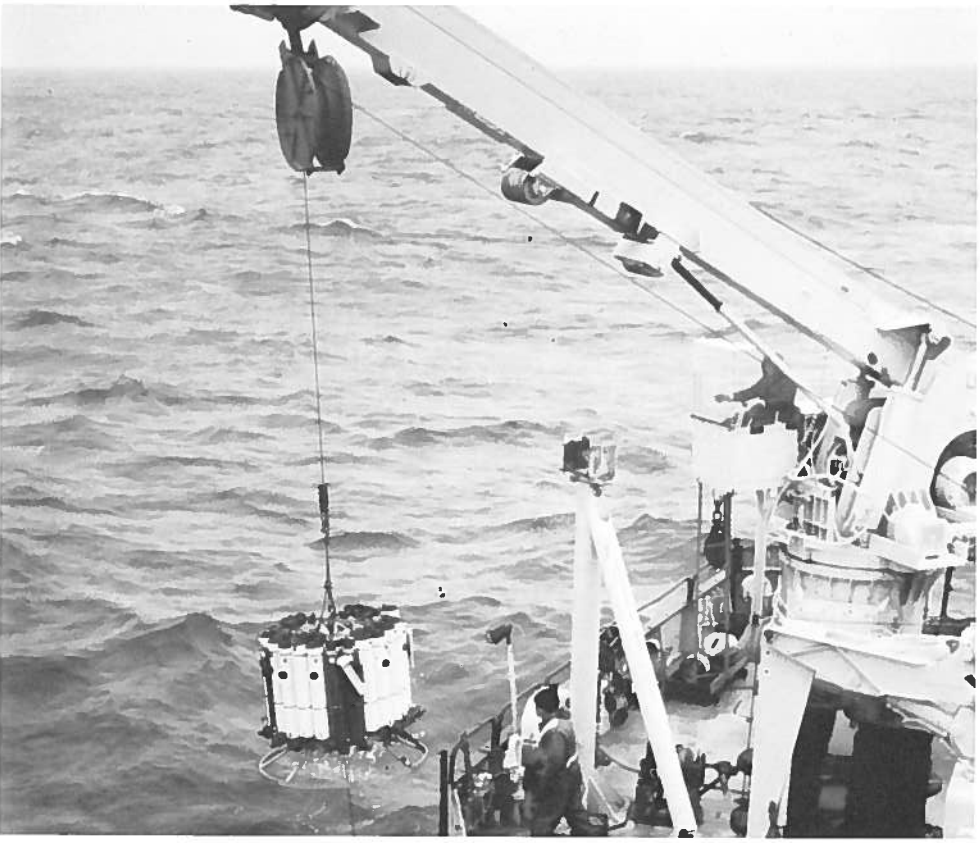
COLD CONCLUSIONS

There is a final sea frontier on the earth and the Texans are there, too. That frontier is the icy seas surrounding Antarctica. "It may surprise a number of people, but Texas A&M is one of the major players in ocean research of that area," says Dr. Worth Nowlin, a leading physical oceanographer and research administrator in the Texas A&M Department of Oceanography.

"In fact, one of the largest oceanographic programs we ever had at Texas A&M was built around research in the southern oceans," he says. From 1975 through 1984 the university's oceanographers played a significant role in the more than $12 million International Southern Oceans Studies program.

There is no body of water called the Antarctic Ocean. It is simply called the Southern Ocean.

Now Antarctica may be a bit distant from the central Texas campus of Texas A&M, but oceanographers don't have to live near the ocean to do their work. "Oceanography doesn't



In the bitter Antarctica cold, Texas A&M marine scientists (above) prepare to lower a massive underwater sampling unit during a research cruise. The university is a major player in the search for knowledge about this last ocean frontier.

work like that anymore," Nowlin says. "Most everything is done either remotely, sent back via satellite link or the data are recorded in situ on magentic tapes and the instruments recovered later via research vessel."

For example, the Texas A&M team will often put current meters in place and return every year or two years to pick them up. While the meters are in place, they are constantly gathering information on currents, temperature, salinity and pressure.

"The raw measurements are then brought back to Texas and analyzed," he says.

Asked why researchers study such remote spots, Nowlin explains those slate-colored waters hold a key to very core of marine life on the planet.

From the biologist's point of view, he says, the marine food web there is relatively simple. Basically, the microscopic plankton are fed on by krill. Krill is a small, shrimp-like animal, generally less than an inch long. "It is, however, by volume, the largest animal biomass that we have on earth," Nowlin says.

The krill are in turn fed on by whales and seals. The pattern makes for a very efficient food chain with few steps. Today scientists are interested in how that food chain works since the number of whales and seals killed by hunters has been significantly reduced.

While the the biologists are interested in studying food chains for basic information, another group of Texas marine researchers is examining the socio-political consequences of research in that cold, distant land.

There is now a convention governing the harvesting of the living marine resources of the Artarctic, such as krill, whales and seals. A number of countries have signed and agreed to abide by the convention.

There are other considerations that draw the interests of the Texas scientists deep to the south. The potential for future hydrocarbon exploration and exploitation is a leading factor in the push for new, detailed information about the Southern Ocean.

"There may be large potential reservoirs of hydrocarbons along the Antarctic continential margins," Nowlin says. That possiblity has the marine scientist studying not only the geological features, but is encouraging examination of the circulation of currents surrounding the continent.

Environmental considerations are a prime reason. If and when oil companies begin exploratory drilling there, they must have an idea of the circulation system and impact on the environment in case there is a blowout, oil spill or a broken pipeline.

And, finally, the very cold water found deep in the oceans may have an important effect on the world's climate.

"Cold water from the polar regions helps offset the heat input from solar radiation in the tropics," says Dr. Thomas Whitworth, associate research scientist in the Texas A&M Oceanography Department. "Much of that cold, deep bottom water has its origin in the Antarctic."

Whitworth and Nowlin are studing the role of the oceans in influencing climate in a joint study with scientists at Oregon State University. The four-year study is funded by the National Science Foundation.

Because the currents of cold, dense water occur at the bottom of the ocean, they cannot be sensed by satellites. The team will have to use shipboard measurement and an array of meters to study the currents.

They will also look for traces of elements, such as tritium from atmospheric nuclear testing in the 1950s, to detmine how long it has been since deep water was exposed to the atmosphere.

SHIP THE SHRIMP

Far from the frigid waters of Antarctica, a team of Texas A&M researchers are attempting to build a new industry in Texas — the shrimp farm. As odd as that may sound there may be a time in the not-too distant future when the shrimp on your plate will be grown on a U.S. shrimp farm. Recent research breakthroughs here in Texas have brought that possiblity closer to reality.

Dr. Addison Lawrence, head of the Texas A&M Sea Grant shrimp mariculture project in Corpus Christi, says scientists for the first time have successfully crossbred two different species of shrimp — the Pacific blue shrimp and the Gulf white shrimp.

The resulting hybrid was the product of a new artifical insemination technique.

The experiment demonstrated the potential for crossbreeding more closely related species for offspring that grow faster, live longer and resist disease better.

Continued research is the key to development of the American shrimp farm, though. Genetic selection is one of the major tools used to increase production and profitability in other forms of agriculture, Lawrence says. "I think there's a reasonable expectation that we could have commercial shrimp farming in the United States in the next five years," he says.

"If the shrimp grow faster and you get a larger shrimp, you could possibly make more money. If you could improve the flavor and texture, you could increase the market."

Today the Texas A&M Sea Grant project is the largest shrimp mariculture research program in the United States. There's a good reason. The climate and coastal geography of Texas are such that the potential for shrimp farming is greater than in any other state.

Market demand for shrimp has never been greater, Lawrence says, but there are only three commercial shrimp farms in the United States. "The harvest of shrimp from the ocean is at or very near the maximum sustainable yield — we're taking as much shrimp from the oceans as we can on an annual basis," Lawrence says.

While American shrimp farming is in its infancy, the enterprise has become a major industry in some South American countries. About $200 million of the roughly $1.5 billion worth of shrimp consumed in the United States in 1982 came from commercial shrimp farms, he says.

The largest single supplier was Ecuador, where in the past five years the commercially cultivated shrimp have become second only to oil in export value. The Ecuadorian industry was built largely on U.S. technology, but its rapid growth was encouraged by cheaper labor and operating costs, a superior native shrimp, longer growing season and lack of governmental restrictions.

Growth rates are important because larger shrimp are more valuable. The ideal shrimp for Texas would be one that reaches its most valuable size in plenty of time to harvest it from the ponds before cold weather hits — around the end of October.

Dr. Addison Lawrence, (above, left) a Texas Sea Grant mariculture expert, demonstrates a recently developed artificial insemination technique for shrimp. Meanwhile, a technician monitors water quality (above, right) during an experiment.

Lawrence points out that shrimp don't have to be raised within sight of the sea. A good crop of shrimp harvested last year from ponds more than 50 miles inland from the South Texas coast has increased expectations that shrimp can be commercially farmed in arid parts of South Texas and southeastern New Mexico using underground saltwater.

Lawrence, who has been experimenting with growing shrimp in brackish underground water in the region, says a successful experiment near Sal del Rey is significant. Sal del Ray is an historic salt lake 20 miles west of Raymondville in the Lower Rio Grande Valley.

"This is the first time that anyone has obtained commercial production at a site that is inland using completely "unnatural" sea water," Lawrence says. Underground salt water throughout much of South Texas, West Texas and southeastern New Mexico is useless for growing agricultural crops, but it might be used to raise shrimp.

"Artesian brackish water underlying areas of South and West Texas is an untapped resource which holds promise for mariculture," Lawrence says. Thousands of acres of bays and estuaries along the Texas coast also make Texas a prime candidate for various aquaculture endeavors.

Other major findings by the Texas Sea Grant researcher include completion of the successful maturation and reproduction of three shrimp species in captivity. Two of the species come from the Pacific coast of North and South America. The third is the native white shrimp common to Texas.

Other research discoveries include inprovement of feed for larval shrimp using a small experimental system newly developed by Texas A&M's mariculture experts, and progress on an economic simulation model suggests that larger shrimp-raising facilities stand a better chance of economic survival.

Derrick Grubbs

Researchers with the Texas A&M Oil Spill Assistance Team (above) take samples of thick oily goo that covered Galveston beaches last year. The team is often called on for advice concerning oil spill control and potential environmental effects.

CAUTION: OIL SPILL

While development of an inland shrimp source moves ahead, scientists still keep a close watch on environmental problems facing shrimp and the many other kinds of marine life in the waters off Texas.

For instance, last year as road graders attacked the thick goo splattered across Texas beaches from a massive Gulf oil spill washed ashore on Galveston Island, a Texas A&M oil spill assistance team was on the scene. They were on the beach to assess the damage and answer a thousand questions about where the gooey oil would go and what it would do when it got there.

Everyone, from just plain people to politicians, wanted to know if the thick sludge would devastate environmentally sensitive estuaries, choice fishing grounds and a booming tourist industry.

Thanks to more than a decade of prior research, Dr. Roy Hann, head of Texas A&M's Oil Spill Technical Assistance Program, was able to provide some quick but not comforting answers. He gave the first cost breakdown and it was huge. Hann estimated the cost of the cleanup on the order of 5 to 10 times the cost of the oil. That put the bill for the spill between $10 and $20 million. He added that at least 3,000 truckloads of the oily sand would have to be removed from the beaches.

But Hann pointed out that the sensitive marshland inside Galveston Bay was probably safe, even though the oil had passed over choice offshore shellfish beds and commercial fishing grounds. The impact on the ultimate deposition site of the weathered and sunken oil is not known.

The source of the oil was the British tanker Alvenus which had run aground in the Gulf south of Louisiana. The ship's hull cracked around one of its tanks, spewing some 66,667 barrels of heavy Venezuelan crude into the Gulf.

It wasn't the first time the Texans had been called to help in an oil-related emergency.

Texas A&M researchers have been called to some of the worst environmental disasters ever. For instance, in 1978 the oil spill team received word on the breakup of the Liberian supertanker Amoco Cadiz off France's Brittany coast. More than 220,000 tons of oil were released.

Along with members of a task force from the National Oceanic and Atmospheric Administration, the Texas A&M team studied the Amoco Cadiz spill to better understand the behavior of oil, focusing on physical oceanography, the zones of beach impact and the cleanup technology utilized.

"We found we could tell response managers that the cost of dispersant to disperse an oil spill would cost as much as the oil, and that the total cleanup would cost 5 to 10 times the value of the oil and the level of personnel and cleanup time to expect," Hann says.

The information gives those in charge a rapid understanding of the magnitude of the problem in terms of cost, manpower, equipment needs and cleanup duration.

By 1979 the oil spill threat came to Texas as six major spills occurred. The Texas A&M Team studied three — the ESSO Bayway spill in the Neches Ship Channel, the runaway Mexican well Ixtoc I, and the collision between the freighter Mimosa and the Liberian tanker Burma Agate, four miles southeast of Galveston.

The oil spill teal is always technically prepared for the road. However, since the team is essentially a "volunteer fire department" program, the ability to respond depends on the time and circumstances, Hann says.

Boxes of gear are pre-packed, including everything from paper and pencils to sleeping bags. In addition, sophisticated data-gathering equipment such as current meters, weather stations, and oil sampling and analysis kits are at the ready.

The two Texas Engineering Experiment Station-owned research vessels — the *Excellence II* and *Quest* — are the team's floating laboratories. Inflatable Zodiacs, small rubber boats, can be transported by air to spills in foreign locations for inshore sampling. The team also routinely uses Hann's Cessna 172 airplane.

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John Beck

CRUISING

THE TEXAS RESEARCH FLEET

BY NORMAN MARTIN

Life aboard a research ship is not a cruise on the Love Boat.

There are no swimming pools, no bars, no brilliantly beautiful people. Instead, life on a scientific expedition offers something a little different. Invariably, there's all the hard work you can eat. When research teams head to sea, they often have huge amounts of data to gather and a limited time to scoop up that information.

"It's really hard, tiresome work," says Capt. T.K. "Tex" Treadwell, an oceanographer and manager of two ships in the Texas A&M University oceanography research fleet.

"Now, there are cruises where the work load is lighter, but on a typical cruise they try to crowd as much work in as possible. That means they work day and night."

Despite the rough duty, Texas is one of the nation's leaders in numbers of research ships. Led by two long-time marine academic powers — Texas A&M University and the University of Texas —the research fleet that calls Texas its home port numbers approximately 12.

The exact number is difficult to determine because the ships vary dramatically in size and scope of operation. The far and away leader among the Lone Star's research ships is Texas A&M's *JOIDES Resolution*. The huge, 470-foot drilling ship is the base of operations for the world's only research program in ocean drilling.

Some of the state's more petite research ships have special functions. For instance, the University of Texas' 165-foot *Fred H. Moore*, which is often used as a platform for ocean bottom seismic research, is one of the most effective such ships in the U.S. academic fleet.

'Its sole purpose is to take the scientists out to sea so they can collect data.'

There are approximately 200 research ships operating in the world today. These are split as one might expect among the big nations.

The two largest are the United States and the Soviet Union. The U.S. has some 50 research ships and the Soviets have roughly 75. Other countries, such as England, Canada, France and Japan, have four or five research ships each. And almost every country that has a coastline has at least one research ship.

For example, Mexico has two - one based on its east coast and one on the west coast. Still, much of the activity is by the eight major maritime powers.

Here in the United States there are two major operators of research vessels — the federal government and the universities. The federal government, primarily the Navy and National Oceanographic and Atmospheric Administration, have the bulk of the government research ships.

Every univeristy that has an oceanographic program has at least one research vessel and some have more. While several of the university-operated research ships travel the world, most will by preference work an area within 1,000 miles of their home port. The Texas research ships often concentrate on the Gulf of Mexico and to a lesser extent on the East Coast.

WAY DOWN DEEP

But, of course, there are exceptions. Texas A&M's recently refurbished *JOIDES Resolution* is one craft that will know no boundaries in its travels.

In 1984 Texas A&M became the world's center for the scientific study of ocean drilling. The land-locked, central Texas university was selected to manage a $255-million, 10-year project to discover more about the mystery of the Earth hidden beneath the ocean floor.

JOIDES, short of Joint Oceanographic Institutions for Deep Earth Sampling, is a consortium of 10 universities and participating foreign countries. Funds for the Ocean Drilling Program come from the National Science Foundation.

The selection gave the university reins to the huge deep-sea drilling ship that can drill at water depths of more than 27,000 feet.

While the official name of the ocean-going beamoth is the *SEDCO/BP 471*, the scientific team in charge named her the *Resolution* after the historic flagship of English explorer Capt. James Cook.

It is one of the world's most modern and best equipped research drillships. Built in 1978, it carries a crew of 52 and can accommodate 50 scientists.

"The *Resolution* is a one-of-a-kind ship," says Dr. Lou Garrison, deputy director of the project. "No laboratory on land or sea has the variety of state-of-the-art instrumentation that we have."

The ship is 70 feet wide and the drilling derrick towers 200 feet above the water line. A specially designed computer-controlled dynamic positioning system keeps the ship over a specific location while drilling.

The scientific equipment on board the ship is located in a seven-story, 12,000-square-foot laboratory stack. All on board experiments are supported by a pair of VAX computers which serve as a central processor and data library for 50 microcomputers distributed throughout the laboratories.

The ship is regarded as sturdy enough to be "ice classed," which means, for example, that it could operate in the Antarctic Weddell Sea, an area of high interest for geophysicists.

The drillship is not owned by the university, but is leased from its owners, SEDCO Inc. of Dallas and British Petroleum of London.

The mission of the *Resolution* and her team of scientists is to learn more about such exotic subjects as the evolution of the oceanic crust and the rearrangements of the continents and oceans, as well as long-term changes in the Earth's climate.

Texas A&M oceanographers and other scientists from the University have been involved in the planning phases of the $30-million-a-year project for more than a year. The program will last a decade, and the ship will circle the globe twice in a search for knowledge about the world's evolution.

The Ocean Drilling Program at Texas A&M follows the successful, 15-year Deep Sea Drilling Project managed by Scripps Institution of Oceanography in California.

Once the ship leaves the Gulf of Mexico, it will not return for years. Early legs of the drilling program include studies of carbonate sediment in the Bahamas, a study of the opening of the Labrador Sea and early rifting processes in the Norwegian Sea.

Each cruise lasts approximately two months, and will carry a different international team of scientists on each leg.

BURIED TREASURE

One of the most distant, but well connected, of the Texas research ships is the *Virazon*. The 65-foot, former Army T boat, is the floating headquarters for Texas A&M's world-renowned Institute of Nautical Archeology.

The *Virazon* and her crew of top-flight archeologists startled the world in 1984 with the discovery of an enormous cargo of Bronze Age trade goods in the oldest ship ever excavated, a 65-foot vessel had that sank nearly 3,400 years ago off southern Turkey.

Researchers at the institute have assisted in the recovery of more than two dozen shipwrecks and related projects on four continents. The Institute of Nautical Archeology, based at Texas A&M since 1976, is considered the premier American research group in the field.

Built in 1953, the *Virazon*, essentially a coastal boat, was aquired by the Texas A&M-based institute in 1980. "It was then we started gutting her and started installing recompression chambers and other diving equipment," says Dr. George Bass, director of the institute.

At present, Bass says the *Virazon* is equipped with a double-lock recompression chamber, bunks to sleep 9 to 12 people, darkroom, drafting table, galley, and high- and low-pressure compressors for filling tanks and running air lifts used in underwater work.

The vessel is used from early spring to late fall annually. "More than half the year she is in constant use," Bass says. When the research team finds an ancient shipwrecks, the *Virazon* becomes the main base for diving operations. In fact, the ship is often moored directly over the excavation site.

If the site is remote or excavation is not expected to take long, the Vizaron becomes the entire base of operations. "We sleep on it, cook on it and dive from the ship," he says.

Home port for the *Virazon* is Bodrum, Turkey.

BUSY BUOYS

One of the nation's busiest research ships is the 174-foot *Gyre*.

The Navy-owned *Gyre*, which is operated by Texas A&M, has toured the world on a variety of research expeditions and even served as the floating headquarters during a search for the ill-fated oceanliner, the *Titantic*.

The *Gyre* carries a crew of 10 and can accommodate up to 21 scientists and their equipment.

During recent times, the ship has averaged 280 days a year away from its home port of Galveston, Texas, putting into other harbors only for supplies, repairs or to pick up a new group of scientists. In 1979 the *Gyre* set a new work record of 349 days away from home, more than 11 months.

"We try to keep it as busy as possible because the costs go on whether you are working or laying along side the docks," Treadwell says. Simply running the research vessel costs about $6,000 a day.

Basically, the *Gyre* is a seagoing laboratory and data collection facility.

"Its sole purpose is to take the scientists out to sea so they can collect data," Treadwell says. "That can mean anything from physical and chemical factors to sediment and biological specimens."

Collecting data is not an end in itself, though. The scientist must then determine what the information means. Data can be analyzed either at sea during the cruise or in the laboratory when the scientists return. The final analysis and preparation of scientific papers takes place back on shore.

"Ordinarily we figure that for every month the ship is put out to sea, they should be able to gather enough data to keep a scientific party busy for several months back ashore," Treadwell says. "It's a very concentrated data collecting and gathering expedition."

Equipment aboard the *Gyre* includes such standard research instruments as salinographs, thermographs, a computer, a magnetometer, dredges, sample bottles and other material for studying the sea and ocean bottom. Like most seagoing scientists everywhere, those aboard the *Gyre* often lease highly specialized equipment rather than buying expensive pieces outright.

Treadwell says it is not at all unusual for the *Gyre* to carry scientists from research centers other than Texas A&M, and that there are times when no Texas A&M scientist has asked to join a particular voyage. He says most of the major oceanographic study centers routinely swap scientists and ships to make the most efficient use of limited research money.

The *Gyre* is part of the University National Oceanographic Laboratory System. Formed in 1971, the 17-member association of academic ocean science research institutions operates major shared-use facilities, the ships comprising the UNOLS research vessel fleet.

The goal of the organization is to assist in the coordination and scheduling of ships and equipment to make efficient use of finite resources, Treadwell says. The fleet consists of 25 vessels ranging in size from 64 to 245 feet.

Asked what life was like aboard a routine cruise, Treadwell said that other than the research work itself, life during one of the four-week outings can be a bit dull. Treadwell says the *Gyre* has a small lounge where crew and researchers can play music or cards.

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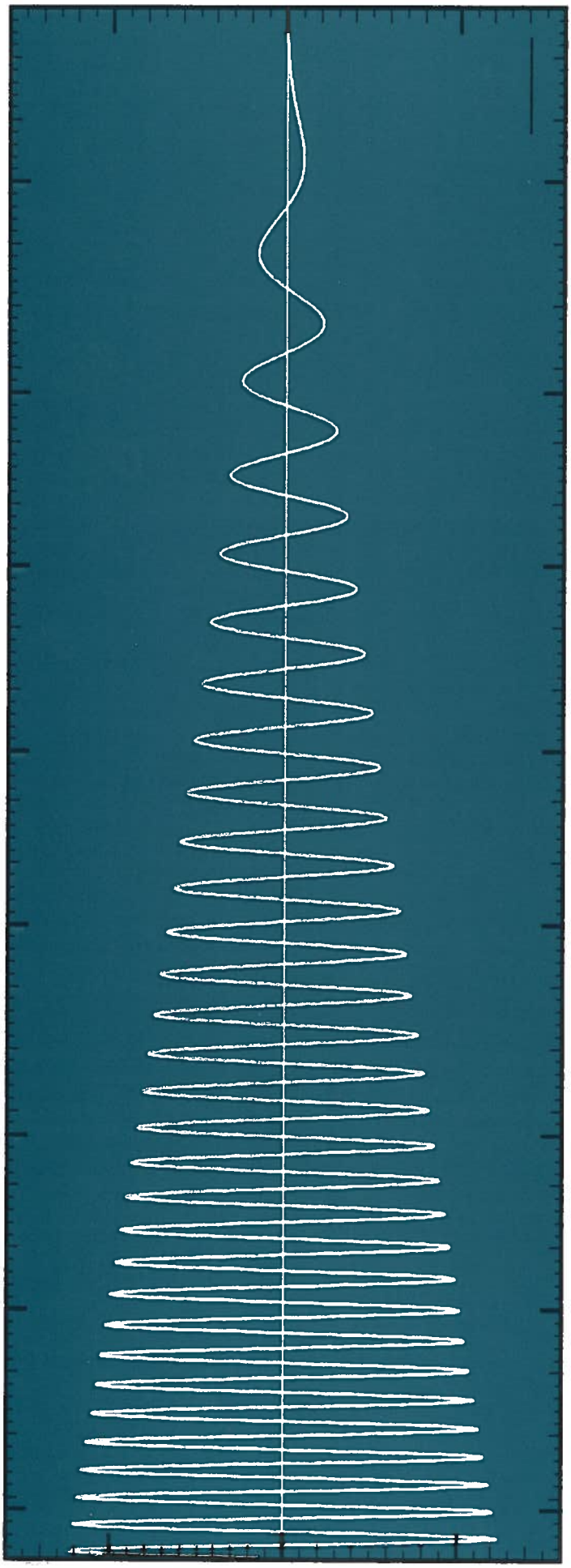
'No laboratory on land or sea has the variety of state-of-the-art instrumentation that we have.'



Computer Graphic Illustration by Steven Worley

R&D

Come with us on a journey into the maze of America's multi-billion dollar marine research and development programs.

David Schink remembers a time in the late 1960s when, as an oceanographer, he was the most popular speaker at junior high school career day. "You'd poll the audience and it seemed that about 25 percent of all the kids wanted to be oceanographers.

"Now this was a profession where maybe 6,000 people had jobs. When you'd think that a quarter of the population was planning to go into it, you realized that we were in for some big problems."

Schink, now an associate dean in the College of Geosciences at Texas A&M University, needn't have worried. For a variety of reasons, the oceanography craze that so captivated a generation of students 20 years ago apparently fizzled out somewhere in the 70s. To the surprise of many, what has materialized instead is a marine science program in the United States that is clearly acknowledged as the leader worldwide.

The reputation does not come without a handsome price. Gone are the days when the cavalier voyages of Jacques Cousteau and the Calypso can provide any meaningful information on topics relevant to the 80s. Big ships, orbiting satellites and mainframe computers are now the essential components of 20th century research.

All this has become so costly, in fact, that only a relatively few institutions in the United States can continue to support it. What's more, their primary sponsor is the federal government.

BY DOTTY CURTSINGER

WHO FOOTS THE BILL?

The tradition of the federal research patron is nothing new. Uncle Sam has invested heavily in research and development (R&D) since the 1950s, an immediate response to the launch of Sputnik by the Soviet Union. Total national investment in basic and applied research will exceed $40 billion this year. Ocean sciences will receive only a small percentage outright, but the increasingly popular interdisciplinary approach to the study of the ocean will mean additional funds through allocations for geology, geophysics and meteorology.

Research isn't confined to academia, though. Petroleum companies and others in the private sector have poured billions of dollars into ocean exploration, mainly in search of oil. A good portion of the information they distill from the ocean's waters is proprietary, which means its use is classified and off-limits, sometimes for many years to the public.

There's also a smattering of marine research conducted in independent laboratories and foundations for both governmental and private clients.

Indeed, students who envisioned a career in oceanography as life aboard the *Calypso* couldn't have been further from the reality of 1985, Schink says. "Most of them of course thought that oceanography consisted of strapping on a scuba tank and swimming around the water watching the fish swim; hardly anybody does it that way except Cousteau."

It's equally surprising for some, he adds, to discover that Texas A&M, located some 120 miles inland, is one of the older oceanography institutions in the nation, and a prominent player in the field of marine science today.

That prominence is clearly demonstrated by the University's recent acquisition of a $30 million a year, 10-year grant from the National Science Foundation to drill deep into the ocean's crust and analyze the core samples unearthed. The nation's 10 major oceanographic institutions, representing about 80 percent of the funds spent on academic oceanography, were in contention for parts of the grant. Texas A&M walked off with the project with the unanimous consent of the other nine.

The Ocean Drilling Program is but one area of current research. For starters, marine scientists are trying to better understand the role of the oceans in the earth's climate, to analyze the oceans' oil and hard mineral resources, to describe global ocean circulation and to interpret biological and ecological processes in seawater.

CHALLENGING BEGINNINGS

The Drilling Program is also a good representation of the quantum leap marine science has taken from its crude beginnings more than 120 years ago. It was then that the British launched the *H.M.S. Challenger* voyage to collect samples of the seafloor. The vessel sailed 68,000 miles in 3 1/2 years, dredging and analyzing samples from the ocean's floors throughout the world.

"People generally think of oceanography as coming into its own with the Challenger expedition," Schink said. "They learned in that one expedition about half of what anybody knew about the oceans until not too long ago."

It seems fitting that the United States had its own beginnings, be they modest, in the study of the ocean. Matthew Fontaine Maury, a hydrographer with the Navy, began a systematic collection of depth data that developed into the Navy's depth charts. Even before that, though, Benjamin Franklin had a hand in ocean study. As postmaster general, he noticed that mail between the colonies and England traveled faster on American ships than on British ships.

"The reason for that was that the American skippers all knew about the Gulf Stream," Schink said. "It gave them an extra two or three knots on the way over, and they could avoid it on the way back." By interviewing all the ship captains he could find, Franklin eventually charted the path of the Gulf Stream.

World War II, however, provided the impetus for the first major developments in modern oceanography. During the war the military began to appreciate, in one observer's view, how much it didn't know about ocean matters it should know about.

"We lost dozens of ships in typhoons we didn't know were coming. We made landings on atolls and wiped out whole battalions because we didn't know what the tides and bottom topography were off those islands," recalls Feenan D. Jennings, now director of the Texas A&M Sea Grant College Program but one of the first two oceanographers hired in 1958 by the Navy's Office of Naval Research.

"Certainly we couldn't find submarines because we didn't know the temperature and salinity changes or what the weather was beneath the surface, all which would affect the sound path of your sonar gear," Jennings said. "You couldn't even see a sub if it was right below you."

NAVY TO THE RESCUE

The Office of Naval Research, formed by the Navy after the war, was to play a dominant role in ocean research, even as it exists today. Its function was to support basic research at universities throughout the country. It has performed that function extremely well and, in addition, accomplished two other objectives of far reaching consequence.

First, because it was for many years the sole or major federal funding agency for research, it established the pattern for the grant process that many funding agencies follow today. "The whole concept of the federal government supporting basic research at the universities really came out of ONR, and grew to include other agencies later on," Jennings noted.

Secondly, through a deliberate long-range funding plan, ONR determined which universities and institutions would spearhead oceanographic research. The plan further detailed each institution's research emphasis, personnel increases, facility construction and ship acquisition. "We indented to increase our basic support at nine institutions 10 percent a year for 10 years. We came pretty close to that," Jennings said.

Titled "Ten Years of Navy Oceanography," the document soon became known simply as TENOC. Says Jennings, a co-author of the work, "I forget who told us we needed a jazzy name for it, but it was very good advice."

The implications of TENOC soon became apparent for the ocean science community. Institutions which already had an oceanography program — like the Scripps Institution at the University of California-San Diego, the Woods Hole Oceanographic Institution, and the University of Miami — became larger and stronger. Those with only a toehold in ocean research blossomed.

One beneficiary of the Navy's master plan was Texas A&M. In 1959, TENOC infused a generous $120,000 into the University's struggling 10-year-old oceanography department. TENOC planned for that annual research grant to reach $1.5 million by 1969. In addition, the University would receive a $3 million ship, and at least one modern four-engine aircraft "if continued improvements" were made in the use of aircraft for oceanographic research.

Changing events on the national front, however, stalled the University's acquisition of the ship and finally nixed the plane altogether. Part of the responsiblity for federal research funding was being divereted to an emerging independent federal agency, the National Science Foundation. (Texas A&M's long-promised ship, the *Gyre*, finally arrived in 1973, and is still used extensively in chemical and biological ocean research.)

Today, the National Science Foundation has major responsibility for the "overall health of science across all disciplines," and ranks as the primary funder of marine research. Ocean science is, in fact, the largest single item in NSF's $1.3 billion annual research budget. At $125 million, it is larger than either physics, molecular biology or astronomy, and nearly 10 percent of entire the research budget.

WHERE'S NOAA?

Surprisingly, little money is available for ocean research through the nation's ocean agency, the National Oceanic and Atmospheric Administration.

The agency, created in 1970, brought together oceanic and atmospheric programs from several different departments. Nearly everyone agrees, however, that this catchall beginning has obscured a clear sense of mission for the agency. Consequently, its effectiveness and status in the marine science community has been diminished. What monies NOAA does appropriate for ocean science are by and large fed to inhouse labs, those staffed and operated by the agency.

Nevertheless, NOAA does fund the Sea Grant College Program, which provides around $40 million annually to the 29 colleges and universities with Sea Grant programs.

The Sea Grant Program was initiated in 1966 to provide funds for marine research, education and extension activities. Federal funds at each Sea Grant institution were to be matched by private and state money, and used to promote the wise use and development of marine resources. From his perspective in ONR, Jennings viewed the program skeptically.

"I had thought originally that it would be a big boondoggle, another giveaway program." But Jennings says what he thought turned out to be wrong.

The Sea Grant Program was based on the more familiar land grant program, an old concept to agriculture, but a new one to marine science. Texas A&M endowed with a rich land grant heritage, already had in place two of the components required to be a Sea Grant College — a large extension program and a department of oceanography to teach marine science. It received Sea Grant designation in 1968. Notes Jennings, "It was kind of a natural for Texas A&M to be the Sea Grant College for the state."

Jennings says the funds the Sea Grant Program provides to its designated colleges typically fill a void in marine science research.

"We support very little research in historically traditional oceanography," Jennings says. "Most of our research dollars go to programs which are not in the mainstream of bluewater oceanography — aquaculture, fisheries, social and political science, seafood technology, areas such as that."

This multidisciplinary approach, often done in cooperation with private industry, has been a hallmark of the Sea Grant Program since its inception. In the wake of rising research costs, some administrators believe it will become the standard by which marine science, indeed all scientific research, will be conducted in the future.

According to Dr. Duwayne Anderson, Texas A&M associate provost for research, R&D budgets among private industry already dwarf R&D expenditures at any single American university. Unless universities can interact with corporate research programs, "even the largest universities risk becoming a relatively insignificant part of the world's R&D establishment in the coming decades," he says.

For oceanography, that means a thorough reckoning with its most obvious corporate counterpart, the petroleum industry. Oil companies spend an estimated $4 billion to $6 billion annually on geophysical research, according to figures supplied by the geophysical exploration industry. That's the amount it uses as an estimate of market size.

That estimate also includes land-based exploration, but Larry Bowles, a spokesman for the Dallas-based Geophysical Service Inc., points out that any company drilling for oil offshore routinely expects to spend "several million dollars" in a given area. "Off California and Alaska, because of the exceptional amount of protection technology involved, each well will run in excess of $100 million," he adds.

"Construction and maintenance are the major expenses. Only a fraction of that figure will go toward research."

Even if marine science programs could not expect to share in the profits of an oil strike, oil companies and other private industries have been known to share technology and data with cooperating institutions, information which heretofore was considered proprietary.

ACCOUNTABILITY DEMANDS

The constant scourge of belt-tightening and buck-squeezing makes for an uneasy atmosphere in the research community.

Not since the free-wheeling days of the early 50s, when ONR research funds were plentiful, have marine scientists enjoyed near total autonomy in their investigations.

ONR looked to the oceanograpic institution's research scientists to define significant research areas. No agency review was made of the proposals submitted by the institution directors returned. "We just said, 'Here's the funding, go do it,'" Jennings recalls.

Those simple beginnings laid the foundation for today's grant process, which has since become increasingly bureaucratized and tedious. This, according to Dr. Lauriston R. King, deputy director of the Texas A&M Sea Grant Program, is in response to the public's demand for accountability. "People want to know their federal dollars are being well spent, so they want to be sure the researchers' proposals are well reviewed," King says.

The complexity of the process depends in large part on which agency, foundation or corporation a researcher applies to for funding. The National Science Foundation, which awards the largest number of individual grants annually, decides the merits of the proposal based on reviews from the proposer's peers. ONR, on the other hand, depends on a team of scientists and its own program managers to decide whether or not to fund a proposal.

Another consequence of shrinking oceanograhic research funds is the discouraging employment picture marine science students must face. Shortly after the groundswell of oceanography interest in the 60s, many colleges and universities expanded or created oceanography departments. Job-hunting for newly graduated marine scientists was lucrative then.

Now, according to Associate Dean Schink, "it's very, very tough to get a job in oceanography. The academic ranks are filled up, and government is shutting down."

Moreover, graduates today seem to be guided by a more practical materialism than their predecessors of just 10 years ago, Schink says. "We don't have anywhere near the number of people dedicated to saving the world.

"Back in those days, you could save the world and get a job, too."

SETTING SIGHTS

What is encouraging in marine science is the advances in both fundamental knowledge and technology of the last 20 years. Discoveries at sea have been basic contributors to the revolutionary theory of plate tectonics and forever altered the way geologists think about the earth. Previous elementary analogies likened the earth's crust to the skin of a dried apple. Plate tectonics theorizes the earth's crust to be a much harder substance, which breaks up into plates sitting on magma beneath.

"Since one of the fundamental problems that man has as our population grows is finding enough earth resources to keep us going, the revolution in geology by itself has paid 10 times over for all the money society has invested in oceanography," Schink says.

In addition, remote sensing capabilities of satellites, configured and digested by super-sophisticated computer systems, will be used extensively in an upcoming major thrust of climate research, the World Ocean Circulation Experiment, nicknamed WOCE. Researchers think their lack of knowledge of the general circulation of the ocean is a fundamental obstacle to solving problems in climate, ocean pollution and biological productivity.

The outlook is more ambiguous for one arm of the University's marine research program. In each of the last four years, the federal funding for the national Sea Grant Program has been eliminated by the Executive Branch, then restored by Congress. Jennings and King are confident enough of the program's continued existence to outline three areas of emphasis in the coming years.

The main objective is the development of an economically viable and profitable shrimp mariculture industry in Texas. Shrimp mariculture is the largest research project the program supports, accounting for nearly one-eighth of the biennial funding package.

Another long-term goal is to develop a better understanding of the bay and estuary systems of Texas. It is a relatively new thrust, yet one to which Jennings is firmly committed. "I suppose it's one of the areas in which I've been disappointed with our progress," he says. "We know that population increase and development is going to have an impact on the waters and organisms along the coastline. We have not been able to put together what I consider to be an adequate program to try and predict what's going to happen."

The final emphasis is on marine education. This too is a relatively young program, dating from 1980. It seeks to bring marine and marine-related issues into the classroom by involving teachers, as well as students from elementary through graduate school levels.

BRIDGING THE R&D GAP

Sea Grant is not a major research component of Texas A&M, accounting for less than $4 million of the University's $121 million total research figure last year. Nevertheless, it is an important part of Texas A&M's marine research and it fills a void between researchers and developers in marine sciences.

Traditionally, researchers in all diciplines have preferred not to cross the development threshold, leaving that function to the private sector. Most university administrators will agree that development is not a university's business, but because researchers haven't concerned themselves with the application of their findings to problems faced by the public and private sectors, a "serious gap" has developed between research and development, according to Jennings.

"In addition to basic research, one of Sea Grant's roles is to fill that gap," he says. "Sea Grant provides the linkage, the interpretive role for putting basic research in a form useful to the general public."

While the gap between R&D may never close, the relationship between the principals is changing. Private industry is developing a growing appreciation for the role of university research as a long-term, sustained, contributor to fundamental scientific knowledge. Researchers have come to respect private sponsors, both as a source of funding and a market for new knowledge.

"It's generally the private sector's job to develop the research so it can be used in society by whoever needs or wants it," says Bowles. "I think that's appropriate. That's our free enterprise system."■

Q&A

DR. WILLIAM MERRELL

On March 31, 1983, Texas A&M University was awarded the largest research project in its history, a 10-year, $30-million-per-year, ocean drilling program that will give the world's scientists their best look yet at the earth's origin and development.

Orchestrating that research bid was an aggressive 40-year-old physicist who outbid the country's other top oceanographic institutions to bring the Ocean Drilling Program (ODP) to Texas A&M.

In the two years since, Dr. William J. Merrell, an associate dean for the College of Geosciences as well ODP principal investigator and associate professor of oceanography, has overseen a major conversion of an ocean-going drill ship, the hiring of more than 100 staff members, and construction of a $5 million laboratory.

As he prepared the University's successful bid strategy for the drilling program, Merrell drew on his first-hand knowledge of oceanography programs in the U.S., as well as his familiarity with the governmental agencies and political organizations that would eventually decide the project's future. He served for four years as a manager with the National Science Foundation (NSF), and as Texas A&M's representative on the Board of Governors for the Joint Oceanographic Institutions (JOI), a group of the nation's top 10 oceanography schools.

From this broad perspective, Merrell was asked to compare the marine research programs at Texas A&M to those of other institutions.

TS: Can you provide some of the history surrounding Texas A&M's oceanography program?

Merrell: The program was one of those programs started right after the war, quite purposefully by the Navy. In fact they developed a program called TENOC, where they decided to strengthen basic oceanography in the U.S. They had not had an adequate pool of oceanographers in World War II to help with forecasts, antisubmarine warfare and whatever else they needed. So they went to what were the centers of excellence then — Scripps, Woods Hole, Miami, Washington and Columbia — and they added to those established centers of excellence, some new programs in state-supported institutions — Rhode Island, Oregon State, Florida State, Texas A&M, Hawaii — and funded them on a long-term basis.

TS: How did the Navy's program affect Texas A&M?

Merrell: The Navy provided long-term support, and for a long time, oceanography and meteorology, which was funded at that time by the Office of Naval Research too, were by far the major research components of the University, probably up to the 70s or so. Of course they are again if you count the drilling program. But then, they were almost the sole research component outside the agricultural and engineering experiment stations. I mean they were 90 percent or something like that. Now chemistry, physics, techtonophysics, and others have a lot of research.

TS: What other programs were here?

Merrell: Zip, as far as research outside engineering and agriculture. Back in 1949, this was quite a different looking institution. I think mainly it was more applied, state-supported funds, as opposed to national, competed-for research funds. And I think that era lasted up to the 70s.

TS: What changes occurred then?

Merrell: For oceanography, ONR became less of a player in ocean research and the National Science Foundation became the dominant funder. At that point there was quite a bit of shaking out as grants to individual researchers forced out the institutional grants. A&M emerged at least as one of the major players — probably barely in the top 10 in the country. And I think we've pretty much maintained or slightly improved that status up till now. We're surely not in the top five, but we're in the top 10.

TS: What about those institutions in the top five?

Merrell: Well, Scripps (Scripps Institution of Oceanography, University of California-San Diego) and Woods Hole (Woods Hole Oceanographic Institution, Massachusetts) are the two class institutions as far as broad base marine programs. And Lamont (Lamont-Doherty Geological Observatory at Columbia University) is probably still one of the better G&G places in the world (geophysics and geology). They specialize in that, but they also have strong chemistry and physics programs. Those would probably be the top three. I'd say the University of Washington is up there with them. I think anybody who takes an objective look at the institutions would probably rank those as the top four.

TS: And the remaining schools?

Merrell: Past that, you can argue about who's No. 5, and who's No. 7, but it's all in how you define things. Oregon State has a considerably larger oceanography program than we do. However, we have a lot more in engineering, and of course we have the Ocean Drilling Program. If you look at total research dollars, we're probably No. 2 or 3 or somewhere in there.

TS: If you put the dollar figure of the ODP aside, how does A&M stack up against the other oceanographic research programs?

Merrell: We are still in the top 10 but it's difficult to say where, because we're not organized along oceanographic lines here like the other places. The University of Washington for instance has a College of Marine and Fisheries Sciences, or something like that. They're all together in one college.

TS: Along what lines is A&M's program organized?
Merrell: We're just a dib-dab here, a dab there. We have the oceanography department here in the College of Geosciences. You have ocean engineering over in Engineering, you have fisheries and mariculture over in Agriculture, marine biology in Science, and some marine sciences and marine biology at Texas A&M University-Galveston. If you ever put it all together we may have one of the bigger programs in the nation.

Back to your question, I don't put us in the top five, but I do put us in the top 10. Again, it's how you define things. As far as volume, we do quite well when you add it all up — which you probably would at a place like Woods Hole or Scripps, which have all the marine programs together under one roof. We're just not organized in a way where you can really tell what we do in marine resources. Our organization has developed strong individual programs, but we do not have the ocean sciences focused in one organizational entity like other major competitors for research dollars.

TS: Is any thought being given to organizing the University's marine programs to be more like the other major institutions?
Merrell: Well, there have been a number of studies which have recommended different methods of better organizing the marine programs at Texas A&M. The latest is the Baker committee, a committee that was chaired by James Baker, president of JOI, and included representatives from the Texas A&M University System and outside experts. Their report recommends that a coordinator for marine science be established in the Chancellor's office. The recommendation is still under discussion in the administration.

TS: When you directed Texas A&M's bid for the ODP, you must have been right in the middle of the institution's greatest politics. Are they different than anywhere else?
Merrell: I think the politics of marine research are basically involved with facilities. One needs ships to do oceanographic research, and people don't want to give up their ships. For example, in a draft recommendation, A&M's ship was going to be moved somewhere, and we didn't want that. A committee of the UNOLS (University-National Oceanographic Laboratory System) happened to make the draft recommendation.
TS: How can they recommend moving a ship that belongs to A&M, or does it belong to A&M?
Merrell: It doesn't belong to A&M. It belongs to the Navy, and we operate it under a long-term lease agreement. Also, you can recommend anything. Anytime you have an advisory body, they can recommend. However, it doesn't mean they can actually do it. Anyway, they recommended to move the ship, and it made us quite angry, because we have been good ship operators, and we called out some politics at that time.

And when people build a new ship — like if NSF has enough money to build a ship — who do they give it to? Politics really gets into those sort of decisions. There's no way to avoid it, because Senators and Congressmen like to have those kinds of things in their states and districts. It's a big visible thing. So that's pretty obvious. The politics get very heavy and lab directors tend to argue quite a bit among one another about who should have this ship and who should have that ship or facility. However, there seems to be relatively small politics as far as funding the individual grants.
TS: What about the business with the ODP? Is that as political as anything is ever going to get in marine research in the U.S.?
Merrell: I don't know if it was very political at all. It was political in the sense that JOI asked to be the sole source designee to receive funds for the ODP, and they further told the National Science Foundation that they would designate from among their members who would do the different components of what had to be done in the ODP. We, JOI, said we should be a sole source because we represent 80 percent of the people doing oceanographic research in the U.S. And indeed we do. If you look at the dollars, those 10 places take in about 80 percent of the academic oceanographic funding.

NSF bought that concept, and then who was to become the science operator — which happened to be A&M and about 90 percent of the ODP funds, was a decision that was made by the JOI Board of Governors sitting in total.
TS: How was that decision made?
Merrell: The 10 major places sat down and we decided among each other what we would do. We closeted ourselves in Washington for two days and have all agreed not to talk about exactly what happened at that meeting, other than the ground rules, where everybody presented what they thought would be best for the program. Then we voted on it, and the vote was eventually 10 to zero and A&M was designated science operator for the ODP.
TS: What sort of resources, commitments did you have to get from the University to bring A&M's bid up to par with the others?
Merrell: The University offered half-time support for five faculty-level appointments. And they've offered to provide the building for the ODP. It's a very generous contribution. It provides space and faculty appointments to attract outstanding senior staff. Also, the ODP has never paid for a penny of my time. The University has paid for all the time that I've put in the program, and we don't count that as a matching contribution, either.

Obviously I and many others have had to spend a lot of time on the program over the past 22 months and that's been paid by the University. Overall, the University has been quite good to the program.

On the other hand, we do have more than 100 employees now being paid by funds provided by the National Science Foundation and the foreign partners, which is nice for the University. And to have people of this caliber and these strengths here has got to help our overall research program. The equipment purchased by ODP will run in the millions and millions of dollars, and will be available at times for other investigators. It's a trade off.

I believe that both sides got a good deal. A&M is going to do a great job running the ODP and the drillship for the scientific community. And being science operators for the ODP fits quite well in A&M's desire to be a internationally recognized research institution and to develop a premier geosciences program. I think that it's a big step toward becoming a world-class institution.■

SEA NOTES

President names Flipse chairman of ocean panel

A high-ranking engineering official at Texas A&M University has been appointed by President Reagan to chair the National Advisory committee on Oceans and Atmosphere, a major panel dealing with national marine and atmospheric science policy.

Prof. John Flipse will serve for a period of three years, according to the White House. The 18-member group that Flipse will head undertakes continuous review of national ocean policy, coastal zone management, and atmospheric science and service programs in the United States, as well as advising the Secretary of Commerce.

Flipse, 63, is associate vice chancellor for engineering of the Texas A&M University System and associate dean of engineering at Texas A&M.

Flipse just ended a two-year term as chairman of the National Research Council's marine board and served on various government advisory panels dealing with marine sciences, ocean industries and the Law of the Sea.

Nautical archaeologist receives British honors

Texas A&M University researcher Dr. George Bass was the man of the hour when he recently announced findings from the excavation of a Bronze Age shipwreck off Turkey.

Lost amid the publicity was the fact that Bass had been quietly honored twice in Britain for his contributions to nautical archaeology.

In the weeks just prior to the public announcement of Bass' Bronze Age excavation by the National Geographic Society, the pioneer researcher was in Scotland as holder of the Geddes—Harrower Chair of Greek Art and Archaeology at the University of Aberdeen.

Bass was only the third American to fill the chair, the other two hailed from Harvard and Princeton.

During his stay in the British Isles, Bass was presented the Keith Muckelroy Memorial Prize by the National Maritime Museum at Greenwich for his pioneering contributions to marine archaeology, innovations in underwater excavation, publication of original research and leadership in both archaeology and education.

Advertising and weather reduce drowning deaths

Thanks to an effective anti-drinking campaign, a killing freeze and drought- induced low lake levels, the number of drownings in Texas decreased last year.

During the first eight months of 1984, water safety officials of the Texas Parks and Wildlife Department say water-related fatalities decreased from 465 the year before to 350.

A significant decrease was noted during the early spring and summer periods when drownings usually are most prevalent.

Fatalities were down 50 percent in April, 33 percent in May, 12 percent in June, 50 percent in July and 22 percent in August, says Jeffee Palmer of the department's water safety section.

Accidents on lakes accounted for 42 fatalities in 1984, compared to 59 the year before.

State announces release of Texas bird checklist

Serious birders or those considering taking up bird watching as a hobby may wish to obtain a free booklet from the Texas Parks and Wildlife Department.

"A Checklist of Texas Birds" is a handy 36-page booklet designed for recording bird observations by location or in a diary fashion.

It includes an accurate listing of Texas' birdlife with both scientific and common names.

To obtain copies, write to Park Operations, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744.

Upcoming marine-related meeting schedule listed

March 31-April 3, 1985. *Symposium on the Role of Fish Culture in Fisheries Management*, Lodge of the Four Seasons, Lake Ozark, MO. Contact: Delano Graff, 450 Robinson Lane, Bellefonte, PA 16823 (814/359-5169).

April 26-27, 1985. *10th Annual Marine Recreational Fisheries Symposium*, "Recreational Uses, Production, and Management of Pacific Salmon," Seattle, Washington. Contact: Frank Carlton, Chairman, Marine Recreational Fisheries Symposium, P.O. Box 23298, Savannah, GA 31403.

June 3-9, 1985. *National Fishing Week*. Contact: R.F. Hutton, National Marine Fisheries Service, (202/634-7220).

June 23-28, 1985. *Second International Symposium on Genetics in Aquaculture*, University of California, Davis, CA. Contact: Graham A.E. Gall, Second Symposium, Department of Animal Science, University of California, Davis, CA 95616 (916/752-1257).

July 28-August 3, 1985. *National Marine Education Association Annual Conference*, the College of William and Mary, Williamsburg, VA. Contact: Sue Gammisch, Virginia Sea Grant Marine Education Specialist, Advisory Services, Virginia, Institute of Marine Science, Gloucester Point, VA 23062 (804/642-7169).

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TURTLE WATCH

Another key environmental issue Texas researchers are addressing is bringing new hope for survival of an ancient, but endangered sea creature. So far, the fight to save the sea turtle is a leading example of cooperative effort and basic marine science.

To save the turtle, scientists first must understand how the turtles think. For instance, Texas A&M marine scientists have discovered that sea turtles have a nose for home. Some migratory aquatic animals, such as salmon, use their keen sense of smell to guide them back to their breeding waters. Last year biologists found the first evidence that baby sea turtles have the abilities necessary for imprinting.

Biologist Dr. David Owens, one of four researchers who conducted the tests at Texas A&M, says sea turtles can detect subtle differences in natural water samples by remembering olfactory cues to which they were exposed to as babies. Artificial imprinting is an experimental conservation strategy being used to save endangered animals.

For six years, the U.S. Fish and Wildlife Service has collected more than 2,000 sea turtle eggs annually at Rancho Nue· o, Mexico, the only remaining nesting site for the endangered Kemp's Ridley. Caught in plastic bags as they leave the mother's body, the eggs never touch the beach. They are carried from Mexico to Padre Island, Texas, where the baby turtles hatch and are eventually released.

"The goal is to establish a new, backup nesting beach," Owens says.

Whether imprinting will help establish a second Kemp's Ridley population is still unknown, Owens says. The giant female sea turtles may take as long as 10 to 30 years for return to the nesting beach. "But using a computer analogy, we could say the sea turtles appear to have all the hardware and software necessary for imprinting," Owens says. "Our experiment doesn't prove, however, that they use it. It just shows that they've got it."

The researcher's experiment with four-month-old Ridleys imprinted at Padre Island suggested that the young turtles not only can distinguish a difference between seawater from Galveston and Padre Island, but that they also show a preference for Padre Island water. The preference was determined by the number of times they entered into compartments containing water samples from Galveston, Padre Island and man-made artificial seawater.

"It was as if there was something about the Galveston water that was interesting, but not right." But once the turtles entered the Padre Island water they stayed more than twice the 45 seconds typical of Galveston water. "In the Padre Island water, it's as if they say, 'Aha. This is the place,'" Owens says.

SELECTED SHORTS

The list of top-flight marine research in Texas could fill volumes. Here is a brief summary of a selected few other notable marine research efforts taking place in the state today.

√ **Crawfish for the World:** Texas is attempting to bring the famous Louisiana delicacy — crawfish — to the rest of the world. Texas A&M fisheries specialist Jim Davis is working with eight commercial aquaculture operations on a project to ship frozen crawfish worldwide.

Nationally, 6.5 million pounds of the crustaceans were eaten in the U.S. in 1983, roughly 30,000 pounds by Houston residents alone. Still, Davis says, more could be sold if people would only try it.

"It's a matter of changing people's attitudes so that they'll accept the product, and perfecting the freezing technique so there will be little damage in shipping."

√ **Brine No Bother:** Texas marine scientists are often called on for the straight facts in environmental controversies.

For instance, last year a Texas A&M study concluded that brine discharged into the Gulf of Mexico from the Strategic Petroleum Reserve's oil storage facilities did not significantly affect marine life.

The petroleum reserve program was begun in 1980 to store millions of barrels of oil in salt domes along the Gulf coast. Fresh water is pumped into underground salt domes to dissolve the salt, creating caverns for storage. The resulting highly-salty mixture is pumped into the Gulf.

√ **Sale on Seafood:** The business of fish marketing is becoming a sophisticated science, and Texas researchers are at the forefront of developing new methods to boost all seafood sales.

Dr. Sam Gillespie, associate dean of marketing at Texas A&M, says much of the recent emphasis has been on increasing shelf life by minimizing bacterial invasion. Since 1979, he says, the number of stores handling seafood has doubled and that number is growing.

One way science is improving shelf life is by determining the mechanism which inhibits spoilage when seafoods are packaged in a carbon dioxide enriched atmosphere, says Dr. Gunnar Finne of Texas A&M's Department of Animal Science.

Modified and controlled atmosphere packaging, storage and distribution of fresh seafoods eventually will result in longer-lasting and better-looking products, he says.

√ **Raising Redfish:** Scientists at the University of Texas are laying the groundwork for the commercial raising of redfish, a popular Gulf Coast sport fish.

Dr. Connie Arnold, a mariculture specialist at the univeristy's Marine Science Institute in Port Aransas was the first to successfully spawn redfish that were reared in the laboratory from eggs.

"Selective breeding has let scientists improve traditional agricultural crops, and (it) will be used to produce strains of redfish that grow faster or are more resistant to disease."

√ **Sink into a Shark:** Sharks may look tough in the water, but they're anything but that on the dinner table.

Annette Reddell Hegen, a Texas A&M Sea Grant seafood specialist, has experimented for years with recipes to promote the sale of shark taken from the Texas coast.

Hegen says shark offers an adventure in cooking because of its versatility in a variety of recipes. Shark has no bones. It has a firm texture. The meat is light and the flavor is mild.

And, needless to say, the names of some of the recipes — Curried Shark and Shark Creole — do make a routine fish dinner sound a bit more exotic. ■

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Still, he says, three essential living needs are met during any cruise. "One, is eating, two, sleeping and, three, is doing the science. So, we try to provide the best food, the best bunks and the best laboratories that we can."

Last year Texas A&M added another research ship to its oceanography fleet — the 47-foot *Deborah Suzanne*, a yacht. Built in 1967, it is a steel-hulled vessel similar to a Norwegian trawler.

Jim Parrack, Texas A&M's oceanographic operations manager, says the research ship will be used by the oceanography department along the coast and continental shelf in the Gulf of Mexico. The vessel is especially suited for taking cores and drag net samples because there is ample space in the stern and bow, Parrack says.

The ship will sleep eight and is equipped with the latest in navigation aids, such as LORAN, a satellite radar.

The yacht was donated to the University by Houston businessman M.K. "Ken" Richardson and is named after his daughters.

GETTING GEOPHYSICAL

The research fleet of the University of Texas is led by the *Fred H. Moore*.

Donated to the University of Texas Institute for Geophysics by the Mobil Oil Corporation in December 1978, the 165-foot ship has a flat bottom "mud boat" design. Since its acquisition the *Moore* has been upgraded and equipped with the instrumentation necessary to make it one of the most effective seismic ships in the U.S. academic fleet.

A research unit of the University of Texas, the institute conducts programs in solid earth geophysics and marine geology/geophysics. The *Moore* is used for seismographic exploration and other geophysical research on a worldwide basis.

The ship has extensive scientific instrumentation, in addition to advanced navigation equipment, and has berths for 10 crew members and 23 scientists. Most of the research done on the *Moore* has been multichannel seismic acquisition on cruises that have taken her throughout the Gulf of Mexico, Caribbean and the North and South Atlantic oceans.

> The Fred H. Moore is one of the most effective seismic ships in the U.S. academic fleet.

Current scheduling involves increasing amounts of time devoted to ocean bottom seismometer research, expanded aperture seismic experiments and student training cruises.

The Institute for Geophysics' second research ship is the *Ida Green*.

The 135-foot vessel made her maiden voyage for the University of Texas in May 1973, and since then has logged thousands of miles during investigations in the Gulf of Mexico, Caribbean and Atlantic, as well as an extensive tour in the Pacific Mid-America Trench offshore Panama, Costa Rica, Guatemala and Mexico.

Current capabilities of the *Ida Green* include its use as a coring platform, and ocean bottom seismometer recovery vessel. In addition, a recent agreement with the Navy will allow for periodic use of the *Ida Green* as a training and survey vessel.

The research vessel was donated to the institute by Dr. Cecil Green, the founder of Texas Instruments, Inc.

The University of Texas Marine Science Institute at Port Aransas is the home base for several of the university's other research craft.

The mini-fleet is headed by the 80-foot *Longhorn*. The steel-hulled vessel was built in 1971.

Dr. John Thompson, the institute's associate director, says though modest in size, the ship is an extremely capable and versatile general purpose research vessel. It has a crew of five and space for 10 scientists.

The *Longhorn* recently underwent a major facelift as part of a continuing process within the university aimed at upgrading the scientific fleet. Thompson says the *Longhorn* was totally renovated, including the addition of a new coat of paint, new below-deck living quarters, new engines, gears, shafts and propellors.

Another ship shares the institute's dock facilities with the Longhorn, the 57-foot Katy. The *Katy* is the newest addition to the University of Texas fleet. The ship is based on a standard fiberglass hull, but is designed especially for use as a research vessel and for class field trips.

One of the smaller research ships at the Port Aransas marine laboratory is the *Bevo*. Thompson described the ship as a 32-foot, semi-tunnel stern utility vessel.

Its small stature makes the ship particularly well adapted to shallow water work, trawling and transportation of large groups of students, he says. The *Bevo* is powered by a diesel engine and carries a depth recorder and VHF-FM radiotelephone.

Another of the floating laboratories at the marine scince institute goes by the rather basic title of *Flat Cat II*. The 40-foot by 16-foot *Flat Cat* is a steel work barge.

Thompson says the barge has a small laboratory and living quarters module, and when needed, a coring tower can be installed. A slot in the bow permits the coring operations.

The *Flat Cat* can get underway using two methods. Thompson says it can be towed to the research location or powered by outboard motors.

QUEST FOR DATA

And, finally there are the Texas Engineering Experiment Station's two primary research vessels, the 72-foot *Excellence II* and the 48-foot *Quest*.

Both ships use Galveston as their base of operations.

The vessels are used primarily in environmental engineering programs supporting the federal government's Strategic Petroluem Reserve Project, says Dr. Roy Hann, head of the environmental engineering division of the Texas A&M Department of Civil Engineering.

Their activities vary from oceanographic research to water sampling and oil spill control and training, he says. The steel-hulled *Excellence II* is a converted shrimp boat. The *Quest* is a Hatteras yacht.■

PUBLICATIONS

The following publications are available from the Marine Information Service, Sea Grant College Program, Texas A&M University, College Station, Texas 77843. Prices quoted are for single copies, write for prices for multiple copies. Request publication by both title and TAMU-SG number, and send a check payable to Texas A&M University.

CREATING THE COLLEGE OF THE SEA: THE ORIGIN OF THE SEA GRANT PROGRAM. John Miloy. **TAMU-SG-83-604.** 64 pages, 6 photographs. Price: $2 for single copy. Multiple copies, price on request.

Based on John Miloy's master's thesis written in 1976 at Texas A&M University, this book first discusses the "rediscovery" of the oceans and the increasing interest in oceanography after World War II.

Governmental figures proposed many solutions to the problem of coordination of federal oceanographic research. Creating the College of the Sea describes how one such solution, the Sea Grant College Program, came about.

It is based on a review of personal papers and correspondence, particularly those of Dr. Athelstan Spilhaus, and recounts meetings, discussions and congressional debates that led to passage of the Sea Grant Act of 1966.

It includes that original legislation, the Sea Grant Program Improvement Act of 1976, and amendments passed in 1978 and 1980.

VENOMOUS MARINE ANIMALS. Poster, 24 1/4" x 18 1/4". $1.00 for single copy. Multiple copies, price on request. **TAMU-SG-82-403.**.

The Gulf of Mexico is a great attraction to swimmers, boaters, fishermen and offshore workers. There are some marine organisms living in these waters, however, that are potentially dangerous and demand respect.

This four-color poster is intended to help the lay person deal with this danger.

Ten categories of marine organisms are illustrated—jellyfish, catfish, rays, sea urchins, toadfish, stargazers, worm, sponge and octopus.

The accompanying descriptions can help coastal residents and visitors become more aware of how problems with these animals might develop, how they can be avoided and how certain injuries should best be treated if they occur.

1984 YEAR OF THE OCEAN (poster). Single copies free; multiple copies, price on request. 18" X 24". **TAMU-SG-84-111.**

This full-color poster commemorates the Year of the Ocean observance in 1984. It includes a watercolor of the ocean by

artist Jim Raatz framed in a solid black border, and the theme, "The Ocean... America's heritage... America's future."

WHALES & DOLPHINS OFF THE TEXAS COAST. (poster). $3. 36" X 24". **TAMU-SG-84-505.**

This full-color reproduction of specially commissioned work by artist Lori Grassman depicts the five species of marine mammals most frequently stranded off the Texas coast.

The Atlantic bottlenosed dolphin, spotted dolphin, pygmy sperm whale, beaked whale and great sperm whale are included. All are painted to scale, and a brief description of each species is printed on the back of the poster.

TEXAS RIPS! Single copy free; multiple copies, price on request. 11" X 17". **TAMU-SG-84-506.**

Another in Sea Grant's series of water safety materials, Texas Rips! delivers a warning message about the dangerous rip currents along the Texas coast.

A high percentage of drownings occur each year in Texas when swimmers or waders are caught in rip currents adjacent to rock groins, jetties or piers.

In addition to an illustration of a typical rip current hazard, the poster also includes information on how to escape should a person be caught.

EVALUATION OF TEXAS A&M SEA GRANT MARINE EDUCATION MATERIALS. Valerie J. Gunter. June 1984. $2.00 for single copy; multiple copies, price on request.47 pages, appendices. **TAMU-SG-84-204.**

Since the Texas A&M Sea Grant marine education program began publishing supplemental classroom material in the late 1970's, the staff has proceeded under various assumptions about who uses the material, how it is used, and how dissemination occurs.

A random-sample survey was conducted in 1983 to test these assumptions. This report is a compilation of the survey results.

The findings indicate that the materials are being disseminated into the general population, but that two-thirds of the users live outside the state of Texas and only half are elementary or secondary teachers.

PROTECTING YOU BOAT AGAINST SEVERE WEATHER. Dewayne Hollin and Ken Pagans. **TAMU-SG-84-511.** Single copies free; multiple copies, price on request. 8 pages; 9 tables, 1 photograph.

There's no guarantee that a boat or its occupants can escape damage or injury during severe weather. But knowing what to expect from an approaching storm or hurricane and how best to prepare a boat against that threat can help increase the chances that the vessel will withstand possible damage.

The key to protecting boats from winter storms, hurricanes or any threatening weather is planning, preparation and timely action. This eight-page guide gives boatowners specific steps they should follow, whether they plan to remove the boat from the storm area, secure it in the marina or take it to a hurricane hole. Included are diagrams of storm mooring techniques, an easy-to-read glossary of severe weather terms and tips on what to look for in a marina's severe weather preparedness plan.

BIENNIAL REPORT 1981-1983. Norman Martin, Amy Broussard, Rita Arnold and Laura Colunga. **TAMU-SG-85-102.** Single copies free; multiple copies, price on request. 48 pages, 2 figures, many photographs.

The research, education, management and extension activities of the Texas A&M Sea Grant College Program for 1981-1983 are outlined in a series of articles and photographs.

Each section tells the Sea Grant story by focusing on individuals in the Marine Advisory Service, Marine Education Program, Marine Information Service, as well as research areas of mariculture, health and safety, fisheries, and ocean processes.

In addition, the report contains a summary of each research project conducted during the period, a financial breakdown of funding, and a directory of the Texas A&M Sea Grant administratiave staff and members of the Marine Advisory Service.

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