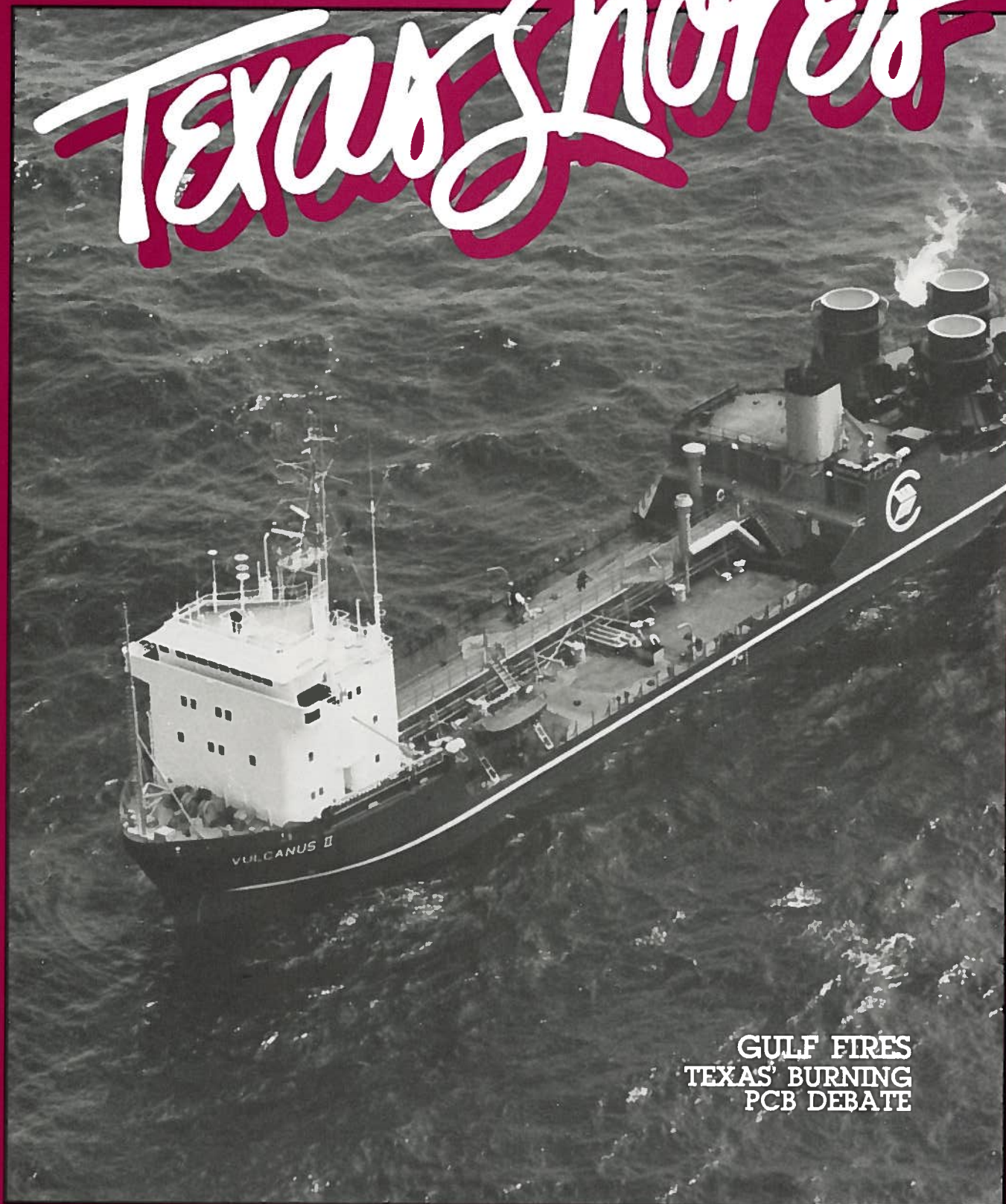


TEXAS SHORES



GULF FIRES
TEXAS' BURNING
PCB DEBATE

Formerly The University & The Sea

Spring 1984

TEXAS A & M UNIVERSITY
SEA GRANT COLLEGE PROGRAM

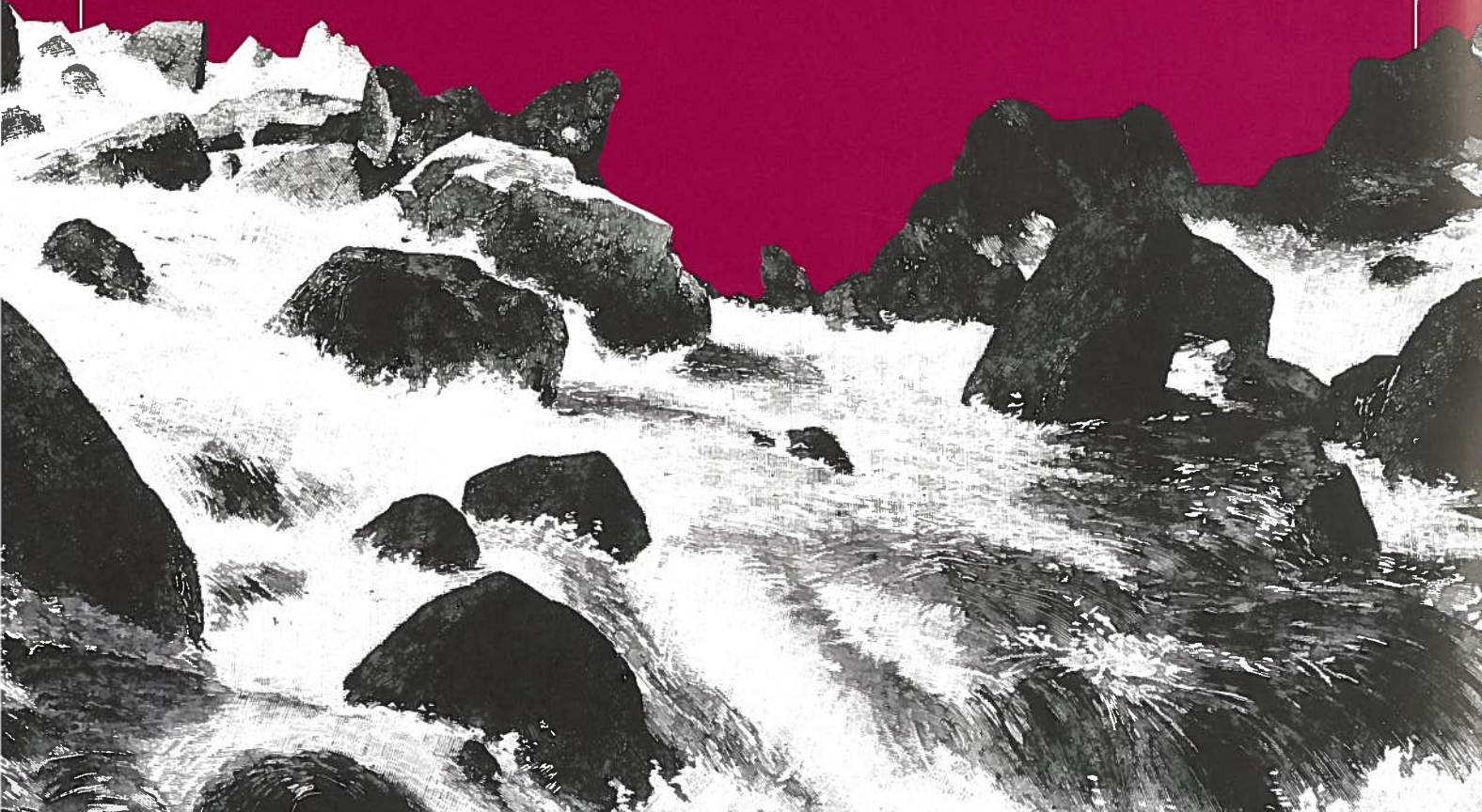
OH, SEA CAN YOU SAY

We invite you to reach out and touch the Texas sea. As part of a special celebration of the Year of the Ocean, the Texas A&M Sea Grant Program is offering three spectacular posters highlighting different facets of the nation's third coast. Available now is "Whales & Dolphins Off The Texas Coast," a 36-x24-inch work depicting in rich blues the five species most frequently stranded along the shoreline. The full-color, quality

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Our two other posters are free. "1984: The Year of the Ocean," is a 18-x24-inch presentation that includes a watercolor of an ocean wave (painted by artist Jim Raatz) framed in a thick, solid black border. Finally, there is "Texas Rips!" The 11x17 poster delivers a warning about the dangerous rip currents along the Texas coast.

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Sea Grant College Program,
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Texas Shores

Readers of *The University and the Sea* may have noticed that, starting last summer, each issue has been devoted to a single theme—a marine-related problem or topic of importance to Texas and Texans. Along with our new approach, we now have a new look and a new name—Texas Shores.

We will continue to bring you in-depth articles about one of the Lone Star State's best kept secrets—America's Third Coast, the Gulf of Mexico. In this issue, the Gulf gets a "report card" from marine scientists, and we take an up-close look at the controversy surrounding the proposed burning of PCB wastes off our shores, find out what PCB's are, and examine the complicated question of jurisdiction over waste disposal in the Gulf.

Our cover photograph, provided by Chemical Waste Management, Inc., pictures the *Vulcanus II*, a specially-designed ocean-going tanker containing high-temperature incinerators for burning liquid hazardous wastes.

If you have been receiving *The University and the Sea*, you will now receive *Texas Shores*. We want to hear from you. Give us your opinions of *Texas Shores* and suggestions on how to make it better.

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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*, Photography, unless otherwise indicated, by Norman Martin.

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.

Change of Address, Subscription Information or Other Questions: *Texas Shores*, Sea Grant College Program, Texas A&M University, College Station, Texas 77843. Or call 409-845-7524. Please include old label when changing mailing address.

Postmasters: *Texas Shores* (ISSN 0274-6476), formerly *The University & The Sea*, is published quarterly by the Sea Grant College Program, Texas A&M University, College Station, Texas 77843. Second class postage is paid at College Station, Texas.

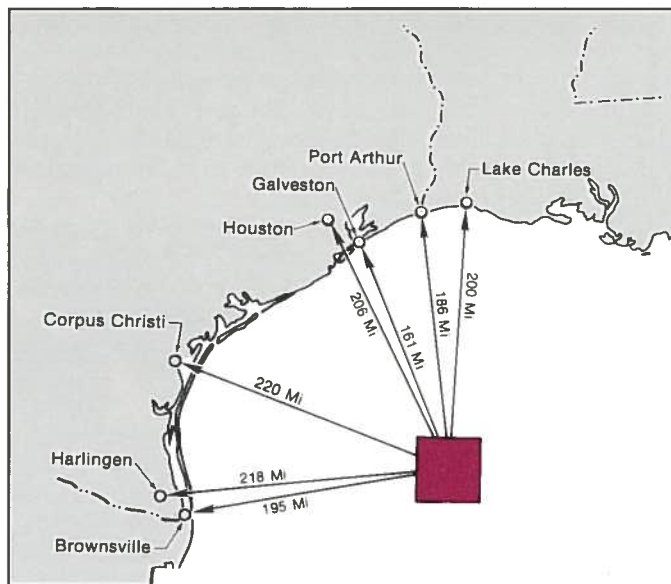
TEXAS BURNS

BY NORMAN MARTIN

A BURNING PCB CONTROVERSY RAGES ACROSS THE LONE STAR.

On a hot, muggy August night in 1982, Sue Ann Frugè timidly sat on the back row of the Fort Brown Hotel Fortress Room. Occasionally her eyes would drift from her folded hands to the speaker's table where eight men sat in a row.

Down front, a government official was leaning back in his chair, gazing out at the 40 Rio Grande Valley residents scattered about the white-walled room that was big enough to hold another 260 people. With a calm, clear voice, he told the staring faces that there was an acceptable answer to America's heated question of what to do with the millions of gallons of toxic waste produced annually. According to the Environmental Protection Agency official, that answer was to burn the toxic waste in the white heat of a floating furnace out in the relative seclusion of the Gulf of Mexico.



"But within 30 minutes it became apparent they didn't have all the answers or were unwilling to tell us what the answers were," Frugè says.

The search for answers has not ended yet. In fact, in many ways it's only begun. But the controversy that boiled up from that unsatisfied gathering in that Brownsville hotel on the tip of Texas has produced reams of newspaper copy, the largest U.S. Environmental Protection Agency public hearing ever held and has coalesced coastal Texas into a grudge match against the federal government demanding a more in-depth review of toxic chemical incineration in the waters of the Gulf of Mexico.

Frugè, now an adamant environmental activist, had come to that first EPA public hearing because so many of her friends had complained of tearing eyes and running noses after a test burn of 800,000 gallons of liquid PCB-

laden wastes out in the Gulf earlier that month.

She doesn't sit at the back of the room anymore. After joining a group of other interested Valley residents, Frugè eventually became coordinator of the Gulf Coast Coalition for Public Health. She stands out front now organizing efforts to stop ocean incineration, but not alone. Governor Mark White, Attorney General Jim Mattox, the Lower Rio Grande Development Council, 22 South Texas cities, 40 Catholic parishes and thousands of coastal residents from Brownsville to Galveston have joined the fray against the EPA.

The EPA is involved in this process under the Marine Protection, Research and Sanctuaries Act of 1972 which requires it to designate appropriate ocean incineration sites and to issue permits to incinerate wastes at those sites.

This is where the Texas coast enters. Since 1974 the agency has issued 10 research permits to test ocean incineration of chemical wastes in the Gulf of Mexico as an alternative to land-based waste disposal. Using results from studies conducted during these tests, the EPA is currently determining whether to issue three-year permits to transport and incinerate a total of 79.7 million gallons of mixed liquid compounds, including polychlorinated biphenyls (PCB) and low concentrations of dioxins. Also included in these liquid wastes are chemicals such as chlorinated benzenes, vinyls, and other organic compounds.

Ocean incineration uses specially designed ocean-going tankers containing high-temperature incinerators capable of burning liquid hazardous wastes under specified conditions. The wall temperatures of the incinerators are required to be at least 1100° C during the burns. Currently, two incinerator ships exist — Vulcanus I and II. Both are owned by Chemical Waste Management Inc. of Oak Brook, Ill. Another company, At-Sea Incineration, plans to complete construction of two ships this year.

Surprisingly, most experts agree that land-based incineration is safer than burning wastes at sea, because of the added hazards of transporting wastes over long distances. Still,



Sue Ann Frugè worries about the Valley.

ocean incineration is less expensive than land-based waste disposal because federal regulations do not require the use of costly antipollution devices, such as stack scrubbers, which limit the amount of waste that can be processed during a given time.

As a result, larger volumes of waste can be processed faster in an ocean burnoff. The main by-products of incineration are hydrochloric acid, carbon dioxide, water vapor and some ash. In ocean incineration hydrochloric acid is naturally neutralized by seawater within a few miles of the ship, the ash is disposed of in solid landfills and the heavy metals that are oxidized during burning are released into the atmosphere.

But no matter what is left after the burn, many opponents of ocean incineration believe the Gulf is the wrong place. The incineration site itself is approximately 195 miles south-southeast of Galveston, and extends over an area of more than 3,000 square miles where water depths are greater than 3,000 feet.

A report from the EPA's Office of Public Affairs indicates the location was selected, in part, to minimize the distance these hazardous wastes had to be transported over land before being shipped to sea. In addition, the EPA says the site is in an area of low biological activity and meets the site selection criteria discussed in the agency's Ocean Dumping Regulation.

The view is not shared by several environmentalists and researchers.

"Of all the coastal areas in the U.S., it would be hard to argue that any is less well-suited to incineration at sea, particularly as the technology and incinerator ships proliferate, than the Gulf of Mexico," says Kenneth Kamlet, head of the Pollution and Toxic Substances Division of the National Wildlife Federation in Washington. He points out that the organization is not against ocean incineration, just the selection of a poor site.

"Both in terms of its high biological productivity and in terms of its semi-enclosed status and proximity to populated areas of two countries, prudence would argue for greater emphasis on other ocean areas before resorting to sites in the Gulf."

Dr. Richard Murphy, director of Science and Education for the Coast Society in Los Angeles notes the position of their organization is simple. "We believe that toxic wastes must be destroyed as completely as is technologically possible and as close to the source as is possible; such materials must not enter the sea." Murphy believes the incineration ships currently in use are inadequate for the type of cargo they would burn. Further, he says there are land-based systems that can achieve safer and higher efficiencies of toxic waste destruction, and be more easily monitored.

Dr. Donald Drum, chairman of the Technical Studies Division of Columbia-Green College in New York State notes that General Electric Co. has a system at Waterford, New York, which exceeds the EPA requirements twice over. He adds that the burn ships lack the "best available control technology" as required by EPA to control acid gas emissions, particulate emissions and organic compounds.

Dr. Stephan Safe, a PCB toxicology expert at Texas A&M University, believes the danger is not just in the burning, but in the case of a disaster at sea. "The last place that you site an incinerator involved with the destruction of PCBs is in an aquatic environment. It's the absolute worst site because you get the worst possible environmental disaster or effect if you have an accident.

"You have no chance of cleanup," Safe says. "It goes and it's in the sediments and in the water sediment interface. It's bioaccumulated and

that's it. You're in big trouble."

Dr. David Owens, a biologist at Texas A&M, says he fears large scale incineration of wastes in the Gulf will have a detrimental effect on the five endangered sea turtle species that make their home there. "The sea turtles will most certainly come into direct contact with the toxic materials which they could ingest and be directly poisoned," he says.

"Also, sea turtles, as predators, would be prime candidates to accumulate the toxins that might be taken in via their invertebrate food sources. If we can just learn a little more about these animals in the next decade, we may be able to develop ways to recolonize the near extinct populations."

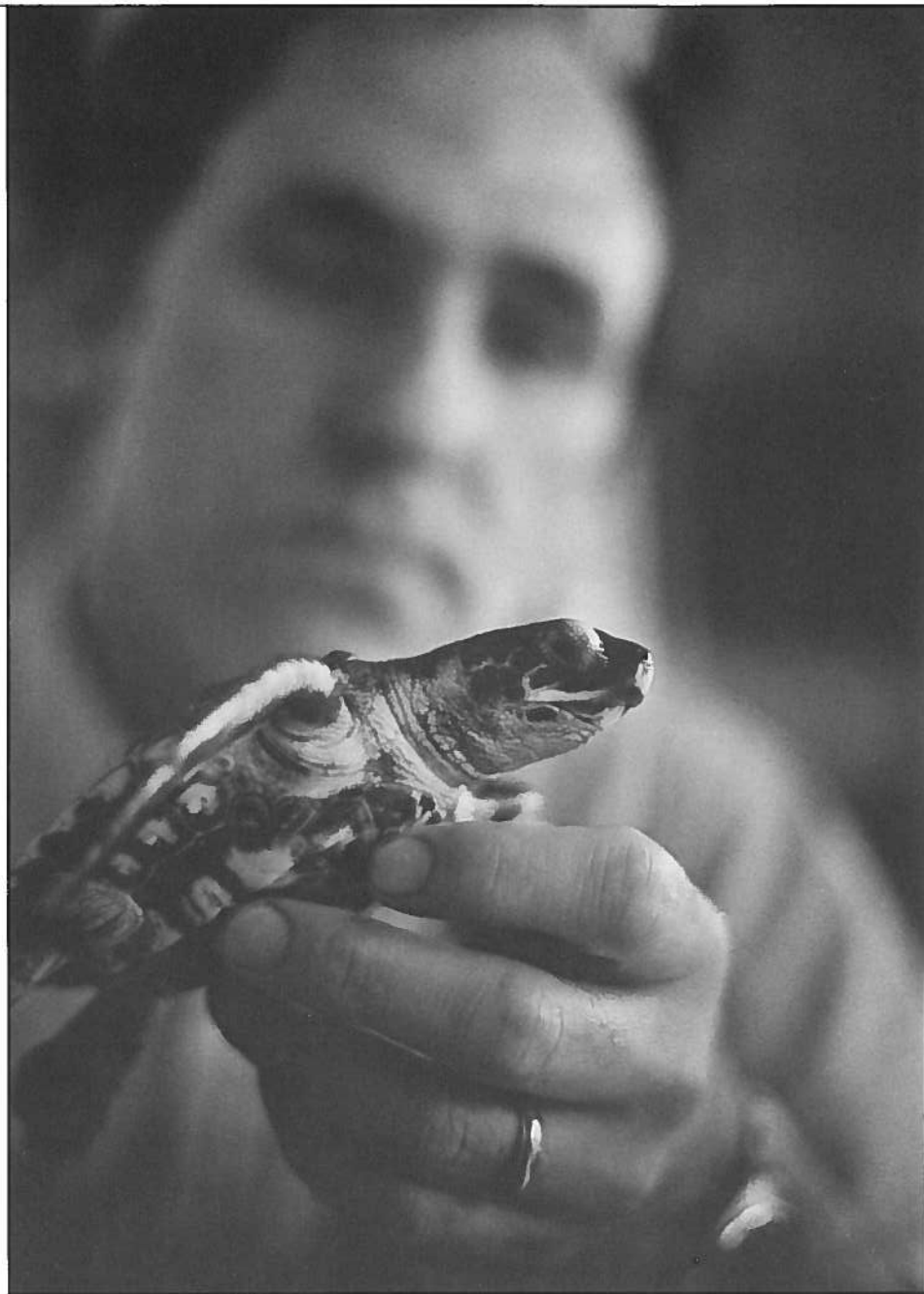
Officials of Chemical Waste Management do not view ocean incineration quite so darkly. "Ocean incineration is a safe and effective means of destroying large quantities of hazardous liquid wastes stored throughout the United States as well as the increasing volumes of hazardous wastes currently being generated which are best disposed of through thermal destruction," says Frank Krohn, Chemical Waste's vice president in charge of Vulcanus operations.

Bob Reincke, manager of Chemical Waste Management's public affairs, says fears that one of the incineration ships might sink or be involved in a collision must be put in historical perspective. As late as 1973, he says, 1.4 million tons of chlorinated organic wastes like those burned by their ships were dumped into the Gulf.

That is the equivalent of one ship the size of theirs dumping its entire cargo each and every day year round, Reincke says. Instead, he says, the ships destroy in excess of 99.99 percent of the cargo.

In addition, he says, if one of the ships were to sink, the wastes could remain securely in the eight separate tanks on board each ship. In the unlikely event of a collision, the double hull, double bottom design of the ships, plus the storage of wastes in a number of separate tanks would probably prevent the release of more than a minimal amount of wastes.

In any event, the companies owning the ships must apply for EPA permits to burn wastes at sea and are responsible for meeting incineration



Dr. David Owens, a biologist at Texas A&M University, says endangered sea turtles are prime candidates to accumulate toxins.

performance and monitoring requirements. Construction specifications for incinerator ships are regulated by international rules developed by the International Maritime Organization and the vessels must be certified by the U.S. Coast Guard. According to the EPA, these rules assure safe and efficient transportation, storage and burning of waste materials.

As for the controversy in the Valley over ocean incineration versus land

incineration, Reincke says, the company was surprised that some residents apparently would prefer that the firm incinerate on land instead of more than 170 miles out at sea.

Obviously, he says, there is a need for both land and ocean incineration, and the company has two facilities on land with hazardous waste incinerators. Even so, ocean incineration offers some unique advantages.

For one thing, Reincke says, the incineration process takes place many

miles out at sea. It is done in remote areas away from homes, schools, offices and factories and remote from shipping lanes, fishing areas and marine life breeding grounds.

Another factor in the Chemical Waste Management decision was that, based on earlier tests, the EPA had concluded that ocean incineration was an environmentally acceptable and cost-effective alternative means of disposal.

Officials of the EPA were unavailable for comment on matters concerning ocean incineration, safety consideration, site selection or potential effects on marine life. A spokesman for the agency in Washington indicated that information concerning the status of the permit application could be released, but further comment on the issue was not allowed since the matter is under current review.

The first incineration-at-sea activities permitted and monitored by the United States took place in 1974 and 1975 under EPA research permits at a site in the Gulf 170 nautical miles east of Brownsville. The burns were conducted on a research basis with extensive monitoring of the stack emissions and the ocean near the incinerator ship. The EPA officially designated an incineration site in the Gulf of Mexico in 1976 to be used for a period of five years.

From October 1974 to April 1977 a total of about 29,100 metric tons of mixed wastes from the Shell Chemical Company in Deer Park, Texas, were burned at the site aboard the Vulcanus I, which was then owned by a West German steamship line. Results of the burns yielded combustion efficiencies (a measurement of incinerator performance) of greater than 99.9 percent, the EPA says. The principal by-products of combustion were hydrochloric acid, carbon dioxide and water vapor.

During May and September of 1977, under a permit issued to the U.S. Air Force by EPA, about 10,400 metric tons of dioxin-tainted Agent Orange, the herbicide used in Vietnam, were incinerated at a Pacific Ocean site approximately 118 miles west of Johnston Island, 715 miles southwest of Hawaii, where the bulk of the herbicide had been stored. The burn site itself was designated by the EPA solely for this purpose and

only for the length of time needed to complete the burn.

The current controversy over incinerating PCBs in the Gulf of Mexico began when the EPA received a request from Chemical Waste Management for a permit to incinerate PCBs aboard the Vulcanus I.

The EPA redesignated the Gulf of Mexico site for incineration of chemical wastes at sea on April 26, 1982. Additional permit applications to incinerate other wastes at the Gulf site are also presently being considered.

In December 1981 and later in August 1982, two trial burns of PCBs were conducted aboard the Vulcanus I at the Gulf of Mexico site under a research permit issued by the EPA. Brownsville officials and conservationists denounced the move in which the EPA granted the research permit and regulated the two burns.

They complained that the only public notice of the first burn was in a Houston newspaper. In addition, they criticized the agency for not studying the environmental input beforehand and not considering ocean incineration sites other than the Gulf.

"The EPA kept trying to pass us off as a bunch of uninformed, hysterical women."

The first burn incinerated 700,000 gallons of liquid PCB-laden wastes. The test result, however, proved inconclusive because sampling tubes clogged, the monitors on carbon monoxide emissions from the smokestacks malfunctioned and other monitoring equipment periodically broke down.

As a result, a second burnoff of 800,000 gallons was necessary, this time with the EPA taking over monitoring and sampling. The reported cost was about \$250,000.

Even so, the EPA says results from monitoring these burns showed that overall waste combustion efficiency was greater than 99.9 percent and the destruction efficiency for PCBs was better than 99.99 percent. The results exceeded the minimum combustion and destruction efficiency requirements called for in the EPA research permit.

Environmental monitoring in the vicinity of the incinerator ship showed no change in water chemistry nor any impact on the marine environment, the agency says.

Still, opponents contend there is no need for incineration ships or that the at-sea incineration process is inadequate. In a 1983 report entitled "Ocean Incineration of Hazardous Waste: A Critique," Dr. Edward Kleppinger points out that effective, complete destruction of liquid wastes containing refractory chlororganics such as PCBs cannot be carried out in the Vulcanus incinerator system. The report notes, "Valid measurement and testing of liquid waste incineration cannot be performed on the Vulcanus incinerator system. The technology is unverifiable."

The report, prepared by EWK Consultants Inc, a Washington-based firm of environmental management specialists, suggests that the Vulcanus incinerator design cannot achieve an appropriate, continuous, high degree of destruction efficiency.

"We see no need, even if all goes as predicted by the proponents of ocean incineration," adds Frugè. "Under these conditions, ships can only handle a very tiny fraction of the total hazardous waste generated in the U.S. "Beyond that," she says, "these are the very wastes that are capable of reuse and recycling, for energy recovery at a minimum. Why waste this potential by burning at sea?"

Given the new incinerators that have recently been permitted, new incinerators coming on line and increases in incineration capacity as well as the development of cement kilns and chemical dechlorination of PCBs, Frugè says there is probably no need for ocean incineration now or in the future. "These developments have already replaced the capacity to destroy hazardous waste as offered by ocean incineration." she says.

That description of the issue is only

the technical and historical side. The reaction of the people of South Texas is another matter. As the permit process has progressed, the Valley residents began to interpret incineration of PCBs in the Gulf of Mexico as a threat to the health and welfare of the people of the Rio Grande Valley. The Valley is already plagued with 18 percent unemployment, previous damage from hurricanes and oil spills, and economic damage from Mexico's devaluation of the peso. The people concluded that incineration-at-sea was one threat they would fight.

On November 21, 1983, EPA held a public hearing in Brownsville on proposed permits for burning PCBs on the Vulcanus and EPA Office of Water officials were met with the largest audience for a public hearing in the agency's history. A total of 6,100 people turned out to register their almost unanimous protest against the burn.

Most of the participants were strongly opposed to ocean incineration and questioned its safety and the reliability of EPA's test methods and results. Many insisted that EPA's studies inadequately addressed the risks of accidents associated with water and land transport and dock loading. Another concern about these permits was that jettisoning the cargo under life-threatening conditions at sea is not prohibited. Because of the widespread opposition to the permits, the EPA extended the deadline for submitting public comments to until the end of January.

But there are other problems caused by EPA's ocean incineration program. The issue has given rise to a potentially devastating impact on the Valley's economy, which is already suffering badly from the peso devaluation. The mere perception that there is a problem in the Gulf of Mexico has in the past had a dramatic impact on the local economy.

"Tourism is our only industry," says Jane Rosamond, mayor pro-tem of the city of South Padre Island. "It's our lifeblood.

"We have learned in the past that you really don't have to have a problem to reap the results of the problem. If there is even a perceived problem with the burning, it can affect us."



Members of Valley Faith jammed the Jacob Brown Auditorium in Brownsville to voice the Chemical Waste Management.

Valley residents recently have had two painful experiences. In 1979 they endured a massive oil spill from the well blowout of Ixtoc I. The shrimp were never affected yet the market was damaged from mere public perception. Long after the beaches were cleaned, hotel rooms stood vacant. To acknowledge and oppose the issue brings attention and, thus, the very publicity these interests can't afford to have.

The perception problem was seen twice last summer with the close passage of two hurricanes. There was no wind, no rain, and no damage but cancelled reservations left half-filled

hotels because the tourists perceived there was a problem.

Another problem is communication, or lack of it. For instance, when the Gulf Coast Coalition, which had paid to have opposition experts at the huge November hearing, complained that the EPA was not allowing contrary viewpoints to be adequately heard as they had promised, EPA's administrator for water, Jack Ravan, agreed to pay for a scientific debate in January.

At the last minute, legal technicalities prevented EPA from paying travel expenses for the coalition experts, but the scientific forum pro-



Disapproval against the EPA and M. Torres

tions and they either won't or can't give them to us."

Rosamond adds, "The EPA kept trying to pass us off as a bunch of uninformed, hysterical women who were up in arms about something that might affect our children generations hence.

"We're not fools," she says. "We recognize there are problems with toxic waste and it has to be disposed of. But you have to approach the subject of solving the problem with the best means possible at the least risk."

Still, there are those who believe the stand to stop the incineration was worth the effort, even if it ultimately may be unsuccessful. David Eymard, president of the Texas Shrimp Association, says, "We've done a world of good up till now. Had it not been for the opposition and this thing had flown through like it was originally intended, I'm sure the rules and regulations that have since come about would not have been there.

"If nothing else, the effort has more than likely kept people in line," he says.

The public outcry against the burning of toxic chemicals in the Gulf may convince the EPA to stop the planned incinerations and re-examine the direction it has chosen.

Ravan said in an Associated Press report following the scientific forum that the outcry is louder than anything he's seen in a decade. "I have seen this kind of mobilization on an issue only once before. That was on the wetlands issue in Florida in the mid-'70s."

Ravan said the public hearings may cause the EPA to re-examine its direction on disposal of all waste at sea. "It may be time for us to redefine what our policy is with regard to the ocean."

Precisely when the EPA will announce its decision on issuing the burn permits is unknown.

If the EPA determines that the risks of accidents are minimal and that ocean incineration will not unreasonably degrade or endanger human health, the marine environment, or its economic potential, it will issue three-year permits for ocean incineration. In addition to regulations in the permitting process, companies currently applying for ocean incineration permits have submitted a cat-

astrophic contingency plan to the EPA. The Coast Guard is also preparing a regional contingency plan for hazardous wastes.

Payton Davis, a spokesman for the EPA Water Division in Washington, says the next step in the process will be hearing officer Steven Schatzow's recommendation to Ravan. That recommendation should take place around the middle of March, followed by a decision by Ravan on whether or not to approve the Vulcanus permits.

While the direction the federal agency will turn may be unknown now, the EPA in the past has generally viewed ocean incineration as a viable means of waste disposal and has plans for future sites.

Meanwhile, the EPA has indicated that based on the type and amounts of hazardous waste generated in the industrial northeastern United States, along with the costs and hazards associated with transporting wastes to places like the Gulf of Mexico site, a need exists for a second incineration site in the North Atlantic Ocean.

A site has been proposed approximately 140 nautical miles east from Delaware Bay and about 155 nautical miles southeast from the entrance to New York Harbor. EPA says the site was selected for several reasons, including:

- ✓ Its location off the Continental Shelf.
- ✓ Water depths ranging from 7,874 to 9,514 feet.
- ✓ Oceanographic and atmospheric characteristics to efficiently dilute and disperse the trace amount of emissions from the incineration process.

✓ Noninterference with major commercial fishing, transportation or other uses.

✓ And, feasibility of surveillance and monitoring.

A public hearing on the proposed site took place on April 14, 1983, and a decision on the final designation of the North Atlantic site is pending.

EPA is also evaluating a potential Pacific Ocean site for incineration. Ultimately, the agency envisions that all three U.S. coastal ocean areas will be available for this program to safely reduce the nation's hazardous waste inventory. ■

ceeded as scheduled with six EPA technical experts and six coalition-sponsored experts. Meanwhile, the coalition was left with the estimated \$10,000 cost for the appearance of the scientists. The group is still in the process of raising funds.

The battle over the bill was simply another indication of difficulties the Valley organization believes it has with Washington. "At every turn we are reminded of the cozy relationship that apparently exists between industry and the EPA," Frugè says.

"They have put themselves in an adversarial position," she says. "All we've asked for is answers to ques-

PCB

once a rising star on the industrial horizon of America, has lost its glowing admirers. The hardy, oily liquid was touted for years as the perfect safety buffer in the transmission of high-voltage electrical current.

But it was their long lasting nature that turned polychlorinated biphenyls, shortened now to PCB for everyday use, into what many experts believe is one of the most toxic synthetic compounds ever produced.

Used primarily now in sealed electrical components, PCBs are valued as an insulating medium that will not burst into flame at high operating temperatures. As a result, the material in the past was used in up to 95 percent of all capacitors and five percent of the transformers manufactured in the United States.

"The things are very persistent," says Larry Payne, coordinator of the Oil and Hazardous Material Control Training Division with the Texas Engineering Extension Station at Texas A&M University.

One real danger of PCBs has been concentration in the food chain, Payne says. PCBs tend to accumulate in the fatty tissues of fish and other animals. As each predator eats a smaller organism, it absorbs and retains the PCBs present in the smaller or weaker animal.

By the time a bird eats a certain number of fish a day, even though each fish he eats may have a very, very small level of PCBs, the PCBs are magnified through the bird's intake each day.

"They're stored," Payne says. "You can imagine what would happen after eating so many fish daily would do after five years."

Payne stresses that there seem to be no acute toxicological effects if a person comes in direct contact with PCB, though. "In other words," he says, "if you get some on your skin about the only thing it might do is cause some chafing, unless you happen to be allergic."

Dr. Steve Safe, a specialist in toxicology at Texas A&M, emphasizes PCBs pose a serious health question, particularly in a marine environment.

"Their toxic effects are highly variable," he says. "There are a number of PCBs that exhibit tremendously high activity when you put that mixture in the environment."

Safe stresses that contrary to the popular belief that PCBs do not break down, some of them do. But he adds that many of the ones left are highly toxic. "There is no question about that," he says.

In addition, not all PCBs are considered highly toxic. "Many of them we don't know what they do," Safe says. "But there are several individual compounds that are present in the PCB mixtures that bioaccumulate in

the food chain and are highly toxic to animals.

"We have to presume that they are toxic to humans and use the animal experiments as a predictive model. You can't feed humans PCB in controlled laboratory studies.

"Moreover, some PCBs are fairly active tumor promoters in animals. Again, we don't know about humans, but after all we assess every other drug and product put on the market by animal studies. Why should it be different for PCBs?"

Monsanto Co., the sole American producer of the compound, differs with this assessment of PCB.

A statement on PCB health effects issued by the company notes, "PCBs have been widely and mistakenly regarded as among the most toxic compounds known. They frequently have been incorrectly labeled as deadly toxins and cancer-causing agents. The weight of scientific evidence, however, including many health effects studies done in the last few years, indicates that PCBs are neither extremely toxic nor carcinogenic."

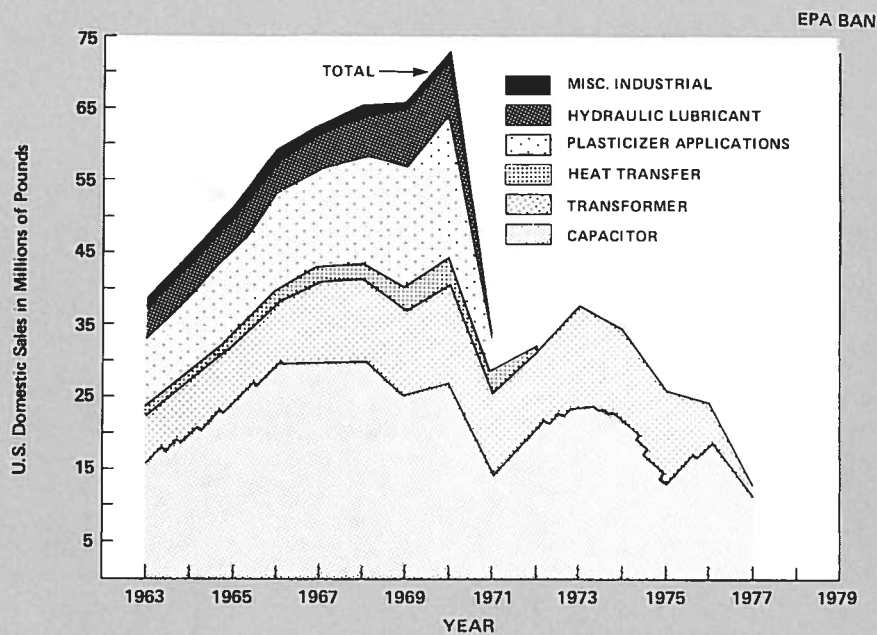
Monsanto cites a 1982 review of current scientific literature on PCB health effects done by independent consultants and submitted to the U.S. Environmental Protection Agency which indicates, "At human exposure levels as high as those previously encountered in occupational settings, PCBs can cause chloracne and increases in the levels of one or more liver enzymes.

"Neither effect represents a serious or life-threatening health problem. From present evidence, no firm associations can be made between PCB exposure and any other human health effects, even after long-term

THE RISE AND FALL OF PCB

BY NORMAN MARTIN

U.S. DOMESTIC SALES OF PCBs BY CATEGORY
(The Uppermost Curve Represents the Total Sales)



occupational exposures.”

In addition, a April 1982 review of PCB epidemiologic studies by Monsanto Company’s Dr. William Gaffet concludes, “All studies agreed that there was no relationship between reported illnesses and symptoms and PCB exposures.”

The chemical structure of PCBs has been known for almost 100 years. Commercial production of the material was initiated in 1929 in response to the electrical industry’s need for an improved dielectric insulating fluid which would also provide increased fire resistant benefits when used in transformers and capacitors.

The properties of PCBs — inertness, fire resistance and their ability to act as non-conductors of direct electric current — made them ideally suited for those applications where high-voltage arcing could occur.

As these properties became more

fully understood, other uses were discovered. Their fire-resistant nature made them an excellent choice for use in hydraulic and heat-transfer fluids. Their inertness gave long-lasting qualities to lubricants. They also improved the waterproofing characteristics of surface coatings and offered similar and other benefits to manufacturers of carbonless copy paper, printing inks, plasticizers and special adhesives.

Eventually, PCBs evolved as a special class of chemicals which met important need of both industry and society. It was within this framework that Monsanto and others developed a growing and worldwide business for PCBs. For more than 40 years, the use of PCB electrical fluids was required in most highrise buildings, schools, hospitals and industrial operations where the risks of fires and explosions were a major concern.

But problems began to appear in the late 1960s. In 1968, about 1,000 people in Japan became ill from eating rice oil heavily contaminated with Japanese-produced PCBs. The industrial accident became known as the “Yusho Incident.”

PCBs were being used as a heat-transfer fluid in equipment used to heat the rice oil. A leak developed in the equipment, allowing the PCB to spill into the oil. Symptoms such as skin discoloration, acne-like conditions, eye discharges and central nervous system irregularities began to appear in those who had eaten the oil.

Monsanto says the accident was caused by toxic impurities later identified in the heat transfer fluid.

In 1970, following confirmation that PCBs were present in the environment, Monsanto voluntarily began to phase out sales of PCB products for “open applications” that could lead to uncontrolled environmental release.

These uses represented approximately 65 percent of Monsanto’s PCB sales. By 1972, the company was limiting PCB sales to selected customers solely for use in “totally encased” electrical equipment. Then, in 1976, following indications from the electrical industry that replacement products would soon be in hand, Monsanto announced that it would cease PCB production and leave the business. The shut-down was complete by October 1977.

PCBs continue to be manufactured today by other firms in Germany, France, Italy and eastern European countries for use in many areas of the world. Monsanto says it has no intention or desire to re-enter the PCB business. ■



FIRE **IN THE** **GULF**

The sides are drawn in a multi-million dollar fight over burning deadly toxins in the Gulf. How did Texas end up in this tide of confusion?

BY · RITA · ARNOLD

Since 1969 incinerator ships have routinely burned liquid toxic wastes off the shores of Europe. This spring a decision is expected from the Environmental Protection Agency (EPA) that will determine the immediate future of ocean incineration in United States waters.

Last fall public opposition swelled when EPA announced tentative plans to approve a test permit and two three-year special permits to Chemical Waste Management, Inc. of Oak Brook, Ill., and Ocean Combustion Service of the Netherlands. The special permits would allow 300,000 metric tons of mixed liquid wastes to be burnt in the Gulf of Mexico.

The EPA has permitted burns before, but, if approved, these permits would okay the first large-scale commercial disposal of U.S. toxic wastes by burning at sea.

Incineration at sea involves only liquid hazardous wastes with high BTU values, such as solvents, residue from petrochemical or pesticide manufacture and substances like PCB transformer fluids. Those wastes represent only a small percentage of the estimated 150 million metric tons of toxic wastes created in the U.S. each year. However, advances in design and technology are anticipated that could permit incineration of solid waste at sea as well.

Chemical Waste operates two foreign-built, foreign-flag vessels, Vulcanus I and Vulcanus II. At-Sea Incineration, Inc., is currently building two U.S.-flag incineration vessels with federal loan guarantees from the Maritime Administration and plans to enter the trade this year. At least five additional firms have expressed interest in burning wastes at sea, but their plans are in the very early stages of development.

EPA was created in 1970 and charged with tackling America's growing waste pollution problems. Eventually, the agency was given regulatory control over both ocean dumping and ocean incineration, and the first legislation specifically aimed at setting rules for ocean-based disposal was passed in 1972. That year the United States signed the Convention on the Prevention of Marine Pollution by Dumping Wastes at Sea (London Dumping Convention), an international agreement

"There just wasn't much public interest. But there's been a recognition by interested parties that there are big dollars to be made in ocean disposal or any waste disposal business."

that set standards for destruction efficiencies for substances to be dumped and criteria for dump sites. It described ocean incineration as an alternative to be resorted to only when no alternate land-based treatment capacity was available.

That same year, to follow through on the London treaty, the U.S. Congress passed the Marine Protection, Research and Sanctuaries Act (MPRSA) that described site designation and permitting processes for ocean disposal.

In 1974, EPA said it had no legal jurisdiction over at-sea incineration because the Clean Air Act did not apply outside state territorial waters and the Ocean Dumping Law (MPRSA) covered only direct dumping, not incineration. Admittedly, references to ocean incineration are sparse in MPRSA's more than 50 pages on ocean dumping. But after pressure from the National Wildlife Federation and the chairman of the Fisheries and Wildlife Conservation Subcommittee, EPA reversed itself and agreed that at-sea incineration was subject to both MPRSA and the London Dumping Convention.

Since then, ocean dumping and ocean incineration have been treated

differently under the law. The Resource Conservation and Recovery Act (RCRA), an amendment to the federal Solid Waste Act, established a national hazardous waste regulatory program administered by EPA and said states should eventually take over responsibility for controlling hazardous wastes. State programs that measure up to minimum federal standards can be authorized by EPA to operate in lieu of federal programs. (Texas has interim authority over such a program, controlled by the state's departments of water resources and health.) But, since ocean incineration takes place in federal waters, far beyond state territorial waters (nine nautical miles off Texas), the federal government has retained authority over at-sea burning.

Finally, in 1982, incineration of hazardous waste at sea was legislatively defined as "coastwise trade" under the Jones Act, stipulating that all vessels burning wastes in U.S. waters must be U.S. designed, constructed and manned according to U.S. standards. The legislation also grandfathered the two foreign-built incineration vessels, but said they too must generally meet the same inspection standards as U.S. vessels.

In 1974 EPA permitted the first burn off U.S. shores at the Gulf site. According to EPA, that site, still the only approved burn site in the country, was chosen because of the volumes of toxic wastes generated along Gulf Coast shores by the petrochemical industry. It's best, goes the logic, to dispose of wastes close to where they are generated. Wastes were burned again at the same site in 1977, 1981 and 1982. (A decision on proposed sites in the Atlantic and Pacific is pending until the Gulf permitting issue is settled.)

According to Allan Rubin, an administrator from the EPA Office of Water Regulations and Standards, there wasn't much concern at all over the initial burns. "In 1977 the same thing was true," he said. "There just wasn't much public interest. But there's been a recognition by interested parties that there are big dollars to be made in ocean disposal or any waste disposal business. Land disposal interests have gone on record against ocean incineration and we have a more sophisticated public. Af-

ter Love Canal and the Valley of the Drums, if you're a resident of Corpus Christi, Brownsville or some other coastal community in Texas and you hear that an incinerator ship will be burning toxic wastes 200 miles off your coast, you're liable to say, 'not in my backyard.'"

John Moore, director of the Center for Ocean Law and Policy at the University of West Virginia, describes the growing concern, "Initially people thought of the oceans as an inexhaustible dumping site and they went around, wiley-nily, using the oceans as a giant disposal."

But, as Moore sees it, attitudes have reversed in the last 10 years. "There has been an outcry to stop all dumping and try to assess what the effects are," he says. "I think we'll soon enter a third mode of dealing with hazardous wastes, marked by a desire for careful assessments of all waste disposal alternatives, both on land and at sea, with cost-benefit analysis. The problem facing mankind is what do we do with all the wastes generated by human activities? We want to use the best technology and one of the alternatives to examine is ocean disposal."

But not everyone agrees that ocean incineration should be one of those alternatives. In fact, not even environmental groups have been able to agree on the need for ocean incineration. The National Wildlife Federation, while criticizing the choice of the Gulf of Mexico as a burn site, agrees in principle with burning wastes at sea. Greenpeace and the Cousteau Society adamantly oppose it and the Sierra Club is still researching the issue. Likewise some land-based waste disposal companies give ocean incineration a black eye while other companies are eager to get into the burning-at-sea business.

Last fall, a petition opposing ocean incineration was sent to the White House with 19,000 signatures. Three public hearings were held along the Gulf Coast to discuss the permits and 6,000 people showed up at the meeting in Brownsville, Texas. A Congressional oversight hearing was called in December to examine the issue and a lawsuit was filed against EPA over the permitting process.

That suit was filed to protest what the plaintiffs saw as EPA's failure to

We really can't just call the Coast Guard to wash off the birds. Vacuum pumps aren't really the answer either because once in the water, those materials can't be retrieved.

promulgate specific rules for ocean incineration. They want the agency to set rules first and issue operating permits later. EPA has been considering each permit on a case-by-case basis. The agency says it is developing the special permits as a model for specific criteria for burns at sea that will eventually include a limit as to which compounds are eligible to be burned, operating conditions and performance standards equivalent to those for land-based incinerators and requirements for independent verification of compliance by companies operating incinerator ships.

Robin Alexander from Texas Rule Legal Aid in Weslaco, one of the attorneys who filed suit against EPA says, "MPSA includes ocean incineration, although no specific regulations for burning toxic wastes at sea have been formulated to this day, even though the language of the Act is unambiguous about EPA coming up with such regulations. Up until this last year, only research permits have been authorized by EPA, so they could argue they are still in the process of determining the viability of regulations and they keep saying they are about to make rules. The latest word is that they plan to do so by the end of 1984."

The lawsuit was brought by 31

plaintiffs including the attorneys general of Texas and Louisiana, the towns of Brownsville and South Padre Island, the village of Laguna Vista, several environmental groups, four farmworker organizations, the Sportsmen's Clubs of Texas and others. A federal judge in Brownsville dismissed the case, not on its merits, but because he said the issue should be raised later, after EPA makes a final decision whether to grant permits or not.

Jack Ravan, Administrator for Water at EPA, will be making that decision. He is then required to notify all persons who participated in the hearings as to the outcome so that anyone disgruntled by his decision can request an adjudicatory hearing on the issue. If their request is denied, the permit is granted in 20 days, but they can still appeal the ruling within EPA or take the agency to court.

Alexander says her clients plan to push for an adjudicatory hearing if the permits are granted. But she thinks EPA may back down.

"At the Congressional oversight hearing on ocean incineration in December," she explains, "Congress told EPA they didn't like having ocean incineration permits granted without regulations in place first. They were told. The question now is, were they listening?"

EPA has already changed its initial stance toward ocean incineration in response to public comments. Ravan, testifying at the oversight hearing, said EPA had decided to "restructure its approach in developing conditions for the proposed permits."

Included in the changes:

The original requirement for a 99.9 percent destruction efficiency at sea will be changed to a 99.99 percent efficiency, (and 99.9999 percent for PCB's), the same criteria RCRA sets for land-based burns. Also, EPA is making sure ocean incineration meets Toxic Substances Control Act requirements for burning liquid PCBs and that provisions are made for automatic shut-off devices and a system to determine which compounds in various waste mixtures are eligible for incineration. EPA says it wants to make sea-based technology equivalent to land-based requirements so that ocean burning, according to Ravan, is as "environ-

mentally sound as land-based."

EPA also says it could require permittees to have a sample of the wastes to be burned analyzed before the ships are loaded, and dockside samples of the wastes could be required too.

EPA also proposes to send ship riders along — consulting engineers to observe the incineration firsthand.

Finally the agency will require burn ships to have a contingency plan approved by the Coast Guard.

Even with the added concessions, Jackie Jacobson, a member of the Lone Star Chapter of the Sierra Club, is among those still not satisfied. She's concerned short-term studies of the effects of ocean incineration can't predict what will happen to residue that could be bioaccumulated.

"I'm highly concerned about the biological effects. Plus, sinking or spilling these wastes in the Gulf could have catastrophic effects. We really can't just call the Coast Guard to wash off the birds. Vacuum pumps aren't really the answer either because once in the water, those materials can't be retrieved."

She also echoes the oversight hearing testimony of land-based incineration companies when she argues that burning at sea is wasteful since the heat chemicals generate as they burn cannot be recovered.

Robert C. Gregory, vice president of Rollins Environmental Services, explains Rollins uses high energy liquid wastes on land to burn solid hazardous wastes. He estimates that at-sea incineration could deprive land-based disposal firms of the means to incinerate 200,000 tons of solid hazardous wastes.

Charles Robertson, vice president of Ensco, Inc., another disposal firm, described land-based incineration as slower, but more able to recapture spilled or burned materials if there is an accident.

Agreeing with him, explorer Jacques-Yves Cousteau described land-based systems as safer in comparison. "They involve less transportation, less chance of accidents, better accident clean-up capabilities, higher destruction efficiencies and better monitoring," according to his testimony. Attorney Brian Berwick, attending the hearing to give testimony on behalf of Texas' Attorney General

"Lots of actions EPA has taken in the past have been inspired by legal steps," says Rubin. "Sometimes it may be necessary to lock EPA into a certain course by taking the issue to the courts."

Jim Mattox, added that, "once loose in the marine environment, these hazardous materials will not be able to be removed by any power that exists on earth."

Gregory also voiced another concern: that runaway reactions, sometimes caused when wastes mixed for incineration are incompatible, could prove catastrophic at sea. Such reactions have caused chemical industry fires and explosions.

But Don Carruth, president of the American Eagle Foundation, a Maryland-based environmental group, testified that the main difference between land and sea-based incinerators is that incinerator tankships operate 130 miles or more away from masses of people, vegetation, animals and potable water. Carruth described at-sea incineration as probably "the safest method available to government and industry."

Frank R. Krohn, vice president of Chemical Waste Management, Inc., the firm in the middle of the permitting process, agreed and accused opponents from land-based companies as acting out of competitive considerations, "no matter how it may be dressed in technical arguments." He said hazardous wastes have been

burned in the North Sea for more than 50 years, totaling an estimated 350,000 metric tons worth.

Kenneth S. Kamlet, representing the National Wildlife Federation, testified that he doesn't think the possibility of an accident at sea, however unsettling, should preclude the use of incinerator ships. He pointed to state-of-the-art collision-avoidance equipment and spill prevention safeguards, including the use of segregated ballast tanks and double-bottomed hulls, that would help lessen risks.

"Billions of tons of highly toxic industrial and agricultural chemicals are regularly transported through our inland and coastal waters on thousands of ships every year," he said.

He did, however, disagree with the selection of a burn site in the Gulf of Mexico. "Because of its high biological productivity and semi-enclosed status, it would be," he said, "hard to argue that any coastal area is less well-suited to incineration at sea, particularly as the technology expands and incinerator ships proliferate."

But he adds, "Incineration, whether on land or at sea, is about the best, least risky technology we have for managing existing organohalogen wastes... However, it is far from clear that land-based incinerators are necessarily and in all instances environmentally superior to ship-based incinerators... For example, problems associated with scrubber down-time, and the need to dispose of large-volume scrubber sludges are negative features of land-based incinerators that may somewhat offset the increased risk of collision damage associated with incineration at sea."

EPA's Rubin describes the ocean incineration question as a dispute among a variety of interests: some parochial, some monetary and some genuine concerns. He describes the current ocean incineration site designation and permit processes as "cumbersome and admits that often EPA needs to be taken to court, away from political pressure, to reach controversial decisions.

"Lots of actions EPA has taken in the past have been inspired by legal steps," says Rubin. "Sometimes it may be necessary to lock EPA into a cer-

tain course by taking the issue to the courts. For example, in 1976 EPA was forced by litigation to set up water quality criteria for pollutants, make a comprehensive list of chemical wastes and establish other needed regulations."

Attorney Alexander says states or other affected persons could possibly sue over damages that might occur from at-sea incineration. Plus, she said, people are beginning to look at potential lawsuits from activities on land prior to burnings because transport and storage of hazardous wastes pose environmental threats too.

Texas Attorney General Jim Mattox has been critical of EPA's handling of the permit request and cites it as "one more area of the law in which the federal government has pre-empted the states' rights."

In a telegram to EPA Administrator William Ruckelhaus, Mattox admitted that ocean or land-based incineration has the potential to replace landfilling, "which amounts to merely storing away these dangerous wastes where they will almost inevitably do harm in the future." But, he said EPA needs to make applicants bear a "heavy burden of proof" that ocean incineration is needed and can be safely accomplished under all conditions that can occur in the Gulf.

Texas Governor Mark White questioned EPA's sampling methods during the 1981 and 1982 test burns, saying they were "unreliable and suspect" according to staff of the Texas Air Control Board, Texas Parks and Wildlife Department, Attorney General's Office and Texas Coastal and Marine Council.

White said there is a lack of full information, a lack of a favorable EPA case for this immediate action, and a lack of trust.

He added that suspicion surrounds the motives and the conduct of the company applying for the permit. Safety and environmental protection, not profit, should be the number one concern, White said.

How much weight can state agency recommendations and public opinion carry in the federal decision-making process?

Robert Gallagher, staff assistant with the National Marine Fisheries Service's (NMFS) Office of Protected Species and Habitat Conservation is

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somewhat optimistic about chances for agencies and groups to impact EPA and other federal agency decisions affecting the environment. "If you get a coalition, particularly cooperation between federal and state agencies, something's bound to happen," he said. But it's difficult to gauge how much clout a recommendation has," he said. "It depends on the pressure behind it.

If just one agency makes a recommendation, not much happens. But more agencies together can change a permit. Agencies can have effect — absolutely — but it takes concerted efforts. We objected to a highway project up the Hudson River in New York that would have filled in an area dotted with old piers that was a nursery ground for striped bass. The district judge issued an injunction against the Corps of Engineers to rewrite the environmental impact statement to consider the bass. EPA and the state's fish and wildlife department were with us on that one."

The National Environmental Policy Act of 1969 (NEPA) requires environmental impact statements for actions by federal agencies that could significantly affect the environment, providing a way for citizens to chal-

lenge government's proposed actions. The Endangered Species Act requires consultations with federal agencies about the potential effects agency actions might have on certain species. NMFS recently established a Habitat Conservation Policy that says habitat considerations should be given greater attention in regional fishery management plans.

NMFS operates under the National Oceanic and Atmospheric Administration (NOAA), an agency charged under two federal laws with research into the effects of ocean dumping. H.R. 2900, passed by the House in January, reauthorizes Title II of MPRSA and the National Ocean Pollution Planning Act (NOPPA) that originally charged NOAA with establishing a long-range plan for ocean pollution research.

H.R. 2900 authorizes \$12 million to NOAA in both FY 84 and FY 85, for the research, study and monitoring of ocean dumping and its effects, and focuses these efforts on developing techniques to assess marine degradation and marine assimilative capacity, monitoring of the marine environment, and the development of methods to dispose of materials that will minimize degradation.

Congress is also working on reauthorizing RCRA, considering bills that would control the ocean dumping of hazardous wastes and municipal sludge, authorize user fees for ocean dumping and control the dumping of sewage sludge.

At the same time, the state of Texas has appointed a joint House/Senate study committee on hazardous waste disposal. Although it too is aimed at studying land-based disposal techniques and regulations, recommendations from this study and new federal dumping regulations could ultimately impact ocean incineration.

EPA Administrator William D. Ruckelhaus, summed up the hazardous waste problem in a story in the New York Times, "Clearly, the best step is not to make hazardous wastes at all. The next best thing if you do make it is to recycle it into the manufacturing process. The next best is to destroy it at the site and the next after that is to treat it and keep it at the facility. Once you've tried all these things and it doesn't work, you've got to put it somewhere." ■

ARE WE IN DEEP WATER?

Four marine experts studying pollution in the waters off the Texas coast have issued a State-of-the-Gulf report card.

BY NORMAN MARTIN

THE GRADE so far is a "B," but with a warning the mark could slip as the state's booming population explodes and offshore drilling activity rises. For those who have been away from the sea for a bit, the Gulf of Mexico is an oceanic basin located at the southeastern boundary of North America. Semi-enclosed, the Gulf encompasses about 650,000 square miles.

A number of major American, Mexican and Cuban cities front the Gulf, and several major rivers, including the Mississippi, drain into it. Measuring the effect of a wide variety of potential pollutants, from toxic chemicals rolling down America's inland waterways to simple boat traffic, is an extremely difficult task when you are dealing with something twice the size of Texas. As a result, different researchers with different interests evaluate the dangers from varying perspectives.

Three oceanographers, Dr. Bobby Presley, Dr. Martha Scott and Dr. Tom Bright, and an environmental engineer, Dr. Roy Hann, recently outlined their views, though. The Texas A&M University marine specialists have spent decades examining the Gulf as part of their on-going research efforts.

In general, their conclusion is that the Gulf of Mexico off Texas is in pretty good shape. "We just don't have very many examples of clear-cut environmental damage in the open waters of the Gulf of Mexico," says Presley, a professor of oceanography.

The environmental effects closer to shore are a little more difficult to see. While there seems little clear environmental impact offshore of Texas, the known and potential impacts on the state's bays and estuaries by dredging and development of oil and gas operations are substantial.

"Note must be taken now of the overwhelming importance of Texas' coastal and estuarial ecosystem to commercial and sports fishing, as well as recreation," Bright, a biological oceanographer, says. "More effort should be directed at all levels, to identifying the present and future environmental problems on the Texas Coast."

Because man's activity is so great

Presley, who is a chemical oceanographer, agrees there must be some damage. The uncertainty is due in part to a lack of information and in part to the natural variability in biological systems.

Most of the studies done in the past have been in connection with the environmental impact of offshore mineral exploration, sometimes as far out as 100 miles.

"Almost all of the research has been done out in the open water," Presley says. "So, when we've done these studies, we have found very little impact by man." But one reason for that is there are rather swift currents off the Texas and Louisiana coasts that tend to disperse any pollutants and carry them to the deeper waters, he says.

STILL, BRIGHT BELIEVES that except for a rather substantial amount of debris left on the sea floor, the region's huge offshore oil and gas exploration and development operations have had an acceptable impact on the offshore fishery resources of the Gulf.

But oil and gas operations are only one factor that hold the potential for pollution. Consider:

✓ The Gulf of Mexico is the single most important area of fisheries production in the United States. In 1980 the total landings of all fisheries in the Gulf was about 2 billion pounds, valued at \$463 million dockside, and represented about 31 percent of the total United States landings by pounds and 21 percent by value.

✓ The coastline and coastal waters of the Gulf serve as a recreational area for a significant portion of the U.S. and Mexican populations. Building of new recreational facilities along the coast is progressing rapidly.

✓ Population growth in the five U.S. Gulf Coast states has exceeded all previous projections. The present rate of growth is expected to continue till the year 2000 with an accompanying increase in industrial development and urbanization.

✓ Sixty-five percent of the total 1975 U.S. crude oil production was from Gulf coastal states, and a large portion of this was offshore. This constitutes almost 15 percent of the world's offshore production and comes from more than 2,000 fixed

offshore structures, or two-thirds of the world total.

✓ Exploration and production of Mexico's petroleum reserves is occurring on the Yucatan Peninsula and offshore in the Bay of Campeche. Some experts estimate that reserves in this area exceed those of Saudi Arabia.

✓ Crude oil refining capacity of the Gulf Coast refineries was 37 percent of the U.S. total in 1977 with facilities under construction which, when operational, will bring the total to 58 per cent of the U.S. total this year.

✓ Sixteen Gulf Coast ports, including New Orleans and Houston, the nation's second and third largest, handled 622 million tons of freight in 1977; more than 50 percent of this tonnage was petroleum and petroleum products.

A United Nations Environmental Program report on the health of the oceans issued in 1982 suggests that all these factors must be considered in conjunction with the natural setting of the Gulf of Mexico, especially its semi-enclosed structure and the nature of water movement within it.

THE REPORT NOTES, "A real concern over the extent and potential increase in pollution of the area seems justified. It is not yet clear whether the impact will be immediately and obviously harmful to the marine ecosystem, or be too subtle to assess or even detect in the short term.

"Many of the environmental problems of the Gulf region are common to other geographic areas, while others are related to the unique character of the region itself."

The overall coastal system is affected not only by activity in the marine environment but by everything that man passes down to the ocean through the nation's inland waterways.

For instance, the Mississippi River carries almost two-thirds of the total dissolved and suspended solids dumped in the oceans from the U.S. Since the river drains America's industrial and agricultural heartland, many experts believe it must also carry a large percentage of the contami-

nants that enter the ocean from the U.S.

"During the past few years marine researchers have noticed that waters offshore have unusually low oxygen levels," says Hann. He is head of the Environmental Engineering Divisions of Texas A&M's Civil Engineering Department and Texas Engineering Experiment Station.

"Whether it's partially man-made, partially natural or whether it's an entirely natural condition, we don't know for sure," he says. "We expect to focus on this problem in the near future.

"But we do know the Mississippi River and other rivers bring a lot of diverse chemicals into the Gulf," Hann says. "We're only now beginning to look to see what these material are."

Nevertheless, ways that scientists and engineers go about studying the marine environment have improved significantly during the past decade.

"In the early days of the environmental engineering field, we were expected to be detectives," Hann says. "People were allowed to put anything out of a pipe they wanted, and only if we could identify some harm did you attempt to go back and find out what came out of that pipe." With their early instrumentation it was difficult to show that harm occurred, except in the most obvious cases.

Now, he says, at least there is a emphasis on the "cradle-to-grave" philosophy of controlling hazardous materials before they are released into the environment and levels of instrumentation have greatly improved.

SCIENTISTS HAVE developed rather unusual methods for tracing the paths of pollution. For instance, Scott, a chemical oceanographer, says the fate of plutonium from nuclear fallout is a good tracer for any kind of pollutant that comes from the atmosphere directly down onto the water surface. The method also works well on pollutants that tend to float like oil or a material that is dissolved in the surface water.

"Water on the surface of the Gulf, west of the Mississippi, tends to move toward the Texas coast, and evidence for this shows up in the plutonium data," she says.

"The same process caused the



Dr. Tom Bright



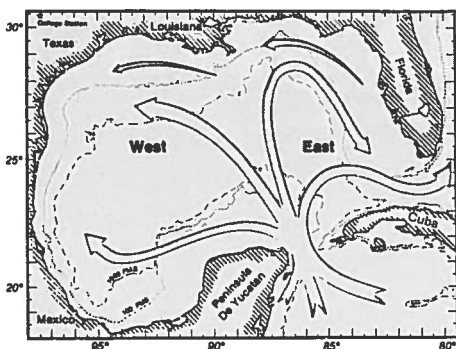
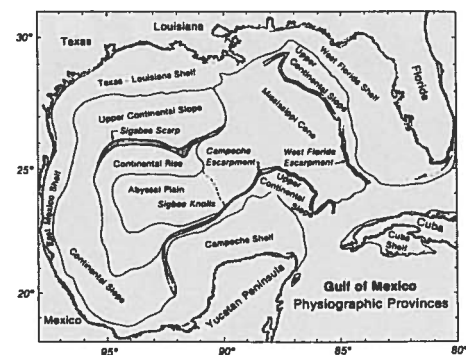
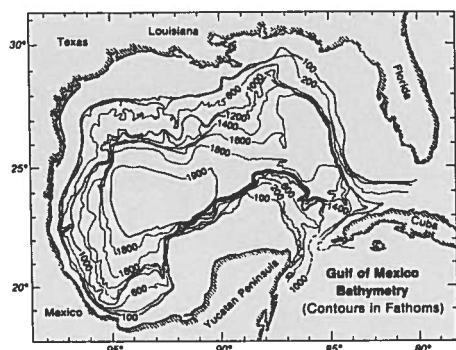
Dr. Roy Hann



Dr. Bobby Presley



Dr. Martha Scott



floating oil from the Ixtoc spill a few years ago to be carried to the shoreline in south Texas."

There is only a very small amount of plutonium in the Gulf, Scott emphasizes, but it is still measurable even though atmospheric weapons testing was stopped in the mid-60's by most nations. By looking at the pathway of plutonium, the Texas A&M researchers have found that after the material landed on the water surface, most of it moved across the Gulf rather than downward into the deep water. The plutonium is now concentrated in the shallow water, she says.

HERE IN TEXAS, two very large scale activities along the coast — oil

and gas development and dredging to maintain harbors and waterways — are the focal points for gauging pollution.

"When you start talking about offshore oil production, you really are talking about the Gulf of Mexico," Presley says. "Activity on the East Coast and West Coast is completely negligible at the present."

But then as far as offshore production goes in the Gulf, the amount off Texas is also small compared to that off Louisiana. Texas at least till now has been spared the environmental impacts of intense offshore drilling, he says.

Nevertheless, those impacts are potentially very great. Many equate environmental impact with an oil spill. Presley says oil itself is probably a minor concern when compared to oil well drilling. Put simply, it is all the other activities that go on in conjunction with putting a drilling rig out at sea and then drilling the well that causes the trouble. The oil rigs must be maintained by transporting material as much as 100 miles from the shoreline.

"There is all this boat activity," he says. "All you've got to do is go to a place like Lake Charles, Louisiana, and just look up and down the shore.

"It's incredible," he says. "There are thousands of boats of every size, shape and description, all of which in some way or another are servicing the oil industry." By far the biggest service activity is the transport of drill mud from shore for use on the rigs.

"Just the presence of these people seems to me to be a problem, over and above whether or not they are doing anything that is adding something toxic to the water," he says.

ANOTHER OFFSHORE concern is placement of major engineering structures in Gulf waters. Texas A&M's environmental engineering team has studied environmental aspects and design of engineered works and products for years, including carrying out the marine aspects of Seadock's environmental study and, at present, the discharge of brine and other materials in the government's strategic petroleum reserve program.

Seadock was a superport planned in the late 1970s to handle supertankers from the Middle East. The \$700-million plan was dropped when two

major oil companies pulled out of the project. A similar project was built in Louisiana though.

"The real message behind facilities such as these is that they can be properly designed to be in reasonable harmony with the environment," Hann says. Indeed, he says, the environmental consequences that researchers have observed from the petroleum reserve program have been modest.

And while not at the top of the hierarchy of major environmental problems, Hann believes the threat of oil spills remains a concern for Texas. A particularly worrisome aspect is that Texas still lacks a mechanism for effectively dealing with a major coastal spill, he says.

"I'm convinced that many people consider contingency planning something you do after the spill occurs, rather than something that you do before it occurs," Hann says.

As for those who consider spill response strictly a job for private enterprise, he says, there is a strong likelihood that a major spill will easily go beyond the capacity of a readily-available contractor.

Often, Hann says, there is a need to turn to the public sector — public works agencies and the military — who are accustomed to handling large numbers of people or large masses of material.

MEANWHILE, ANOTHER pollution trouble spot stems from the state's surging population growth, especially along its booming coastal frontier. Rising census counts and demands for new industry increasingly put pressure on local and state government to improve their waterways by dredging.

"There's just no doubt that very extensive dredging is going on at the present time. And, this activity can do nothing but increase as we get more and more people, more and more boats and bigger ships at the ports," Presley says.

But, he warns, there is a physical consequence when "man just diddles around with the natural processes of water movement." Some of these dredging projects may lead to undesirable consequences.

Hann points out that a distinction should be made between polluted maintenance dredge material and

virgin dredge material removed when a channel is deepened.

"Maintenance dredge material removed after a channel is built is usually more toxic," he explains. As a result, much controversy has existed in deciding just how to dispose of the material.

Despite the controversy, he says, the problem is by no means out of control. "We've got a lot more knowledge and control over monitoring pollution factors than we did 10 or 15 years ago," Hann says.

BRIGHT ADDS THAT there has also been worry recently over potential impacts of offshore oil production on marine environment off the Continental Shelf where many of the Gulf's fishing banks and reefs are located. The Continental Shelf is that part of the sea floor from the coast out to about 100 fathoms depth.

"Up until last year, I've been satisfied with the efforts of the government to protect these reefs and fishing banks from environmental damage due to drilling and production," Bright says.

But in 1983, while offering offshore drilling tracks for lease, the Minerals and Management Service, formerly the Bureau of Land Management, a division of the U.S. Department of Interior, decided to change previous restrictions on drilling operations in the vicinity of the East Flower Garden Reefs. The East and West Flower Garden Coral Reefs, located about 100 nautical miles southeast of Galveston, cover about 500 acres and are the northernmost tropical coral reefs on the Continental Shelf of the Atlantic Ocean. The only reefs that are farther north are those near Bermuda.

Previously, the leases stipulated that there would be no drilling or anchoring activity in the vicinity of this reef in depths shallower than 100 meters. But in the most recent lease offering the Mineral and Management Service was directed to change that figure to 85 meters.

"Essentially that allows for the disposal of drill effluents in such a way that these effluents will undoubtedly contact part of the reef ecosystem," Bright says. As a result, there is a potential for damage to the sensitive reef system.

Coral reefs are the most diverse

marine community. They are comparable to tropical rain forests in diversity and productivity. Built and maintained by reef-building corals and certain types of reef-building algae, they are the home for hundreds of species of fish and hundreds — maybe thousands — of species of invertebrates.

"It is my hope that now with the new philosophy in the Department of Interior, they will revert to the original protective measures for these coral reefs," Bright says.

The economic importance of all facets of the Gulf system cannot be minimized, particularly the environmentally fragile fringe where land and water meet. The Gulf shrimp fishery alone represents the single most valuable fishery in the U.S. with landings (heads removed) averaging approximately 200 million pounds per year.

IN 1977, PRODUCTION reached almost 270 million pounds worth over \$296 million dockside. In addition to shrimp, the blue crab significantly contributes to the Gulf's crustacean landings. About 40 million pounds of blue crabs, worth about \$5-6 million, are taken annually in the Gulf's nearshore estuaries and sounds.

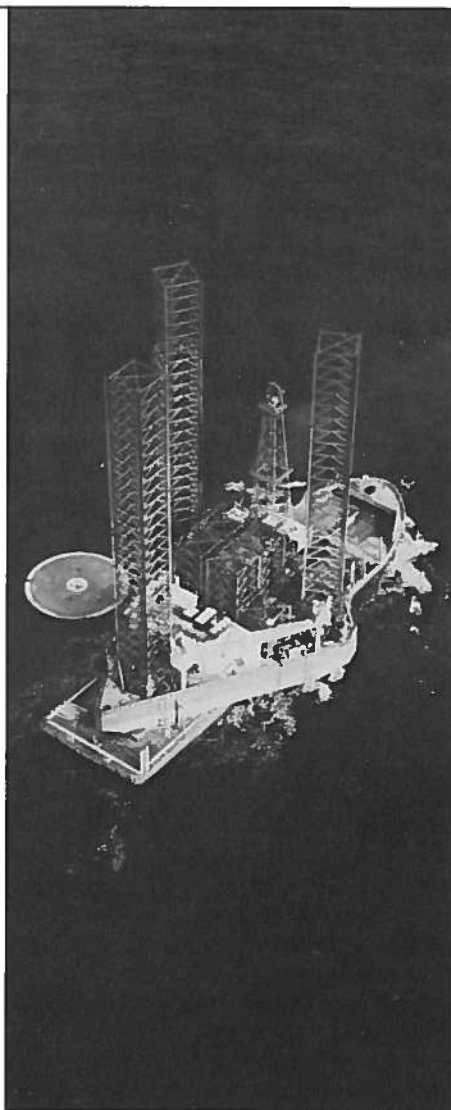
Oyster landings, the main mollusk harvested in the Gulf's nearshore estuaries and sounds, are approximately 14-15 million pounds per year and are valued at \$10-\$13 million.

Several major commercial fishes use the Gulf as home, including Gulf menhaden, red snapper, striped mullet, groupers, spotted seatrout, Atlantic croaker, red drum, pompano, and Spanish mackerel.

The menhadden purse seine fishery is the most important fishery in terms of pounds landed. From 1946-1977, the catch ranged from 80-1,600 million pounds per year, however, most years produce 1,000-1,200 million pounds worth \$40-\$45 million.

The industrial bottomfish trawl fishery produces stock for the pet food industry, bait, animal food, and fishmeal.

THERE ARE PEOPLE who depend on the Gulf for a livelihood, too. In 1976 there were 28,068 fishermen operating 15,229 crafts of various sizes in the Gulf region. This



Gulf drilling rig

Gulf Publishing Co.

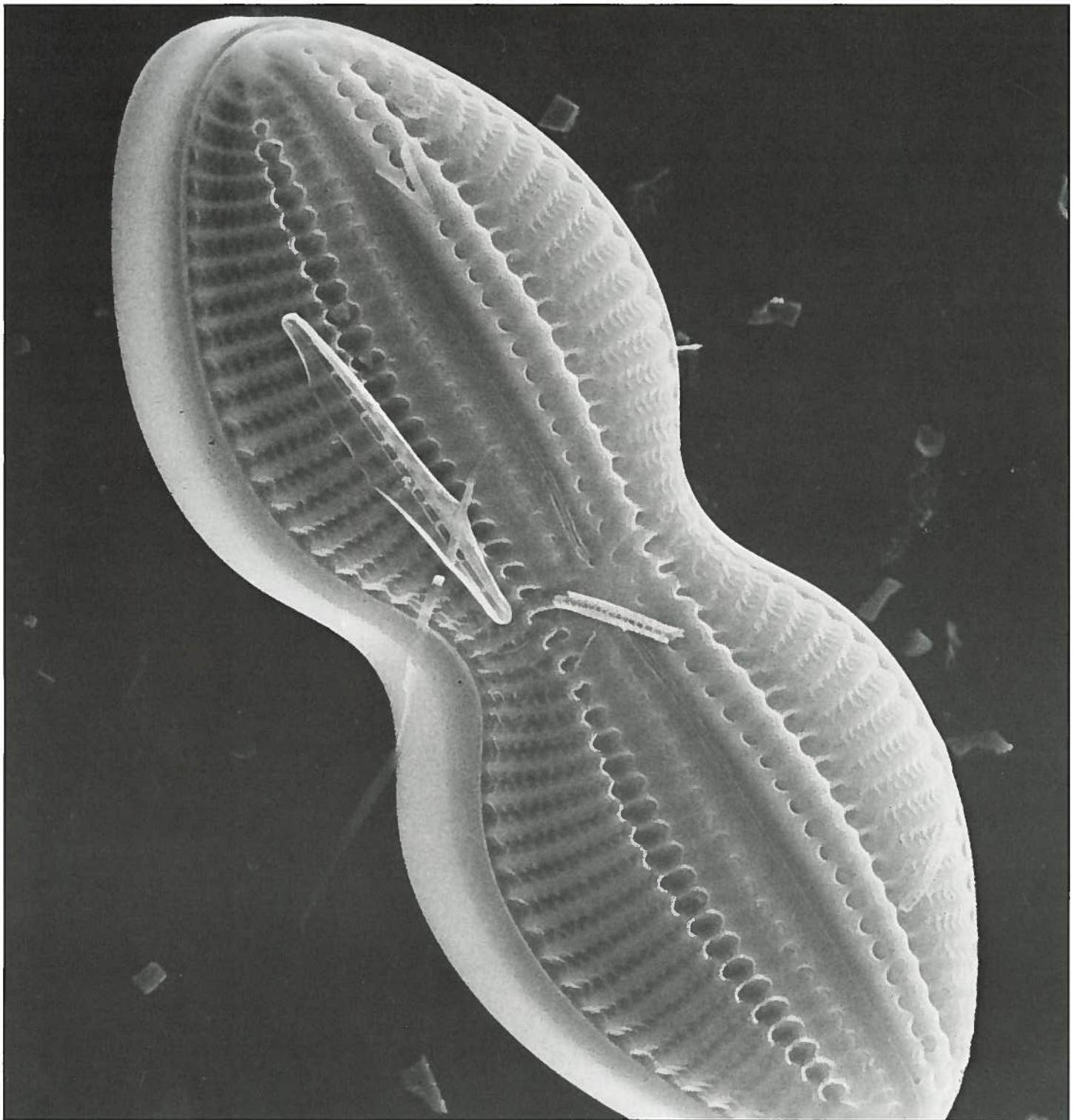
represented about 15 percent of comparable United States employment and vessels.

In 1979 there were 846 processing and wholesale plants in the same area that employed over 13,000 people. Processed fishery products are produced in every state of the Gulf region, and the dependence of this activity on fisheries resources is easily identified.

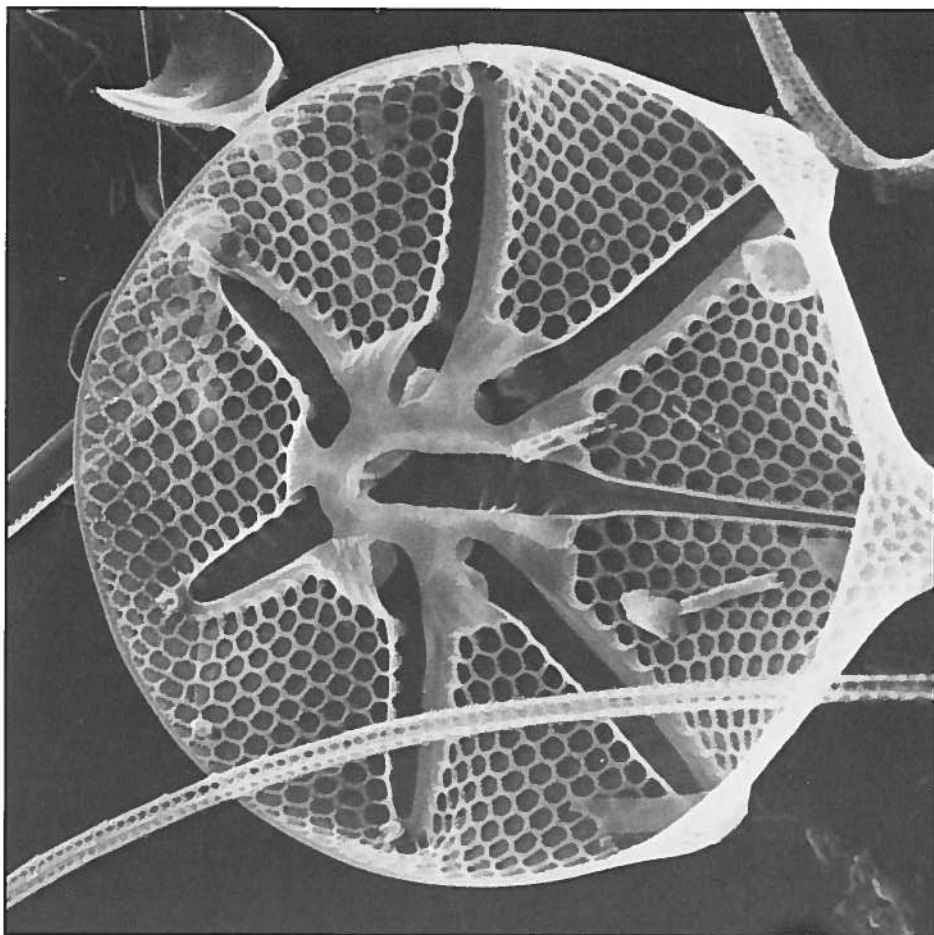
The Gulf region's processed fishery products amounted to about \$661.8 million in 1975 and represented about 20 percent of the comparable United States total.

Most of these valuable fishery species and some potentially valuable species are highly dependent on Texas bay and estuarine habitats, either as required nursery areas or as permanent residences. ■

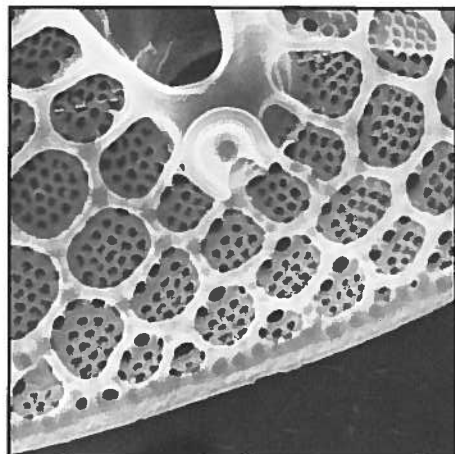
TEXAS SHORES
UP CLOSE



Diploneis weissflogii

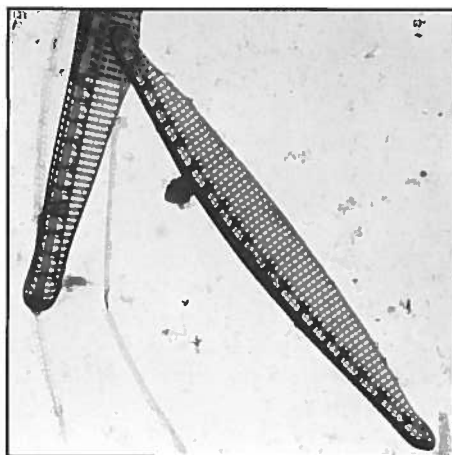


Asteromphalus heptactis

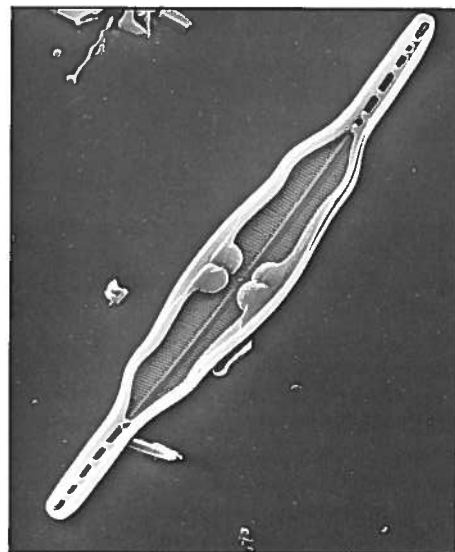


Detail of *Asteromphalus heptactis*

A hidden world unfolds at the hands of Dr. Greta Fryxell. Using scanning and transmission electron microscopy, the Texas A&M University oceanographer studies the opaline cell walls of warm water microscopic plants, called marine diatoms. The single-celled plants are the base of the food chain in sun-lit ocean waters. These particular micrographs represent a diverse flora that dominates much of the earth's surface. The sometime graphically spectacular images are part of her ongoing research program on phytoplankton. All these are illustrated at less than .1mm.



Nitzschia marginata



Mastogloia rostrata

SEA NOTES

Experts say baby whale died from plastic bags

The baby pygmy whale which stranded itself on Galveston Beach in early January died of a bacterial inflammation brought on by an assortment of plastic bags it had accidentally swallowed, veterinary doctors say.

"All told, we found a garbage bag, bread wrapper, corn chip bag and pieces of two other plastic bags that had been ingested just prior to stranding," says Dr. Raymond Tarpley, director of the Texas Marine Mammal Stranding Network and research associate at Texas A&M University's Department of Veterinary Anatomy.

Tarpley said the whale, which had been doing well three days after it was brought to Sea Arama Marineworld in Galveston, contracted severe and acute bacterial peritonitis and gastritis as a result of the obstruction of the first two stomachs caused by the plastic bags.

"Mention water pollution and nearly everyone believes it is wrong," Tarpley says. "But the same people never consider that the potato chip bag they casually toss into the surf is a killer, but it is. That bag, and others like it, killed this baby whale."

Offshore drilling outlook topic of Houston meeting

Prospects for offshore drilling and production beyond 1984 is the focal topic for this year's Marine-Offshore Industry Outlook Conference on April 19 in Houston.

Program officials say the one-day meeting at the Marriot/Astrodome Hotel brings industry representatives up to date on developing trends and problems.

The information is geared to assisting producers better plan and organize their business activities, says Dewayne Hollin, seminar coordinator and marine business management specialist for the Texas A&M University Marine Advisory Service.

Other topics set for review include offshore transportation; marine construction; commercial diving; ship-

building and repair; barges and towing; and tanker operations.

During the conference, two industry panels will also discuss market supply and demand, regulatory problems, technology trends, as well as current and future labor availability.

The program is sponsored by the Texas A&M University Sea Grant College Program and the Marine Services Association of Texas.

Special foundation leads ocean year observance

1984 is the Year of the Ocean.

National Oceanic and Atmospheric Administration officials report that March is the kickoff month for the national observance which is designed to celebrate the importance of the ocean in human life. The observance, which began March 10, marks the first anniversary of President Ronald Reagan's proclamation concerning the Exclusive Economic Zone.

The zone extended the U.S. sovereign rights and jurisdiction to the resources found within 200 miles of the nation's shores.

The Year of the Ocean is not limited to the significance of the zone, though. A national foundation established to administer of the project says the year is a celebration of all the oceans with a particular focus on education and stewardship.

Federal organizations with ocean missions such as NOAA and the National Marine Fisheries Service will open their doors at various times during the year to welcome the public, especially students, to view their facilities. Officials hope the special celebration will kindle new interest in the exploration, research and development of the sea.

The major purpose of the ocean year will be to increase public awareness.

Five objectives have been set for the celebration, beginning with the hope to foster a public and private partnership in the wise use and management of the ocean and its resources.

Review panel completes study of Texas Sea Grant

Research funded through the Texas A&M University Sea Grant College Program has saved Texas shrimpers almost \$30 million and helped make Galveston beach one of the best protected in the country, says a report prepared for National Sea Grant Program officials.

The research and numerous other Sea Grant projects at Texas A&M were discussed in February before a review team of distinguished university and governmental agency administrators from across the country, chaired by Dr. Sanford Atwood, past president of Emory University. The review team visited the university as part of a new recertification process.

"This is part of our effort to be accountable to the taxpayers," says Dr. Ned Ostenso, director of the National Sea Grant Office. "Usually when we visit campus it is to hear about specific project funding requests."

But on their most recent visit, the team wanted to look at the program as a whole, he says. The group also wanted to meet with Texas A&M administrators to get their views on the program.

Ostenso called the Texas A&M program "excellent."

In Sea Grant's report to the panel, officials note that despite the declining purchasing power available to researchers and advisory personnel, significant contributions to the state and nation have been made.

Following the three-day presentation, the review team provided comments and recommendations directly to the Texas A&M administration, as well as the Sea Grant Program leaders at the main campus.

The team members included Atwood, Dr. LeVan Griffis, Dr. Leigh Hammond, Dr. William Ackerman, Dr. Fay Biles and Dr. James Wakelin. Representing the National Sea Grant Office were Ostenso, Dr. Nadia Yolen, Dr. David Ataway, Arthur Alexiou and Dr. Kent Price, an aquaculture consultant for the National Oceanic and Atmospheric Administration.

Clipper's summer cruise includes Europe, Mexico

The Texas Clipper, the training ship of Texas A&M University at Galveston, sails for a tour of European ports this summer and will participate in the Louisiana World Exposition, says university President William Clayton.

The 15,000-ton Clipper goes on an extensive cruise each summer to provide Texas Maritime College cadets the required training hours at sea to qualify for licensing as officers in the U.S. merchant marine. The Maritime College is a unit of Texas A&M University at Galveston.

The ship departs Galveston June 2 for New Orleans where cadets will participate in the world's fair festivities and offer public tours of the Clipper June 5-8. The cadets will also attend a firefighting school at Delgado Community College.

On June 9, the ship sails for Cork, Ireland. The Clipper will also visit Edinburgh, Scotland; Lisbon, Portugal; and Funchal in the Madeira Islands.

Rival schools team efforts in joint marine operation

Research ships flying the colors of Texas A&M University and the University of Texas have completed the first joint marine operation of the two schools.

Texas A&M's 174-foot Gyre and UT's 165-foot Fred H. Moore completed the six-day project late last year. The two vessels had steamed out of Galveston harbor with a complement of 40 scientists and 18 crew members to carry out geological and geophysical experiments along the continental shelf of the Gulf of Mexico.

The trip was the first joint marine operation carried out since the two universities formally agreed earlier in the year to share Galveston-based marine facilities and personnel whenever feasible. More such cruises will be scheduled in the future, officials say.

"We want people to know that the two institutions may have an intense

rivalry on the playing field, but off the field we are eager and willing to work together," says Dr. Gordon Eaton, Texas A&M's provost and vice president for academic affairs.

Dr. Arthur Maxwell, director of UT-Austin's Institute for Geophysics, adds, "I look forward to this being the beginning of more cooperative work between the two universities in the field of geosciences."

Jennings presented AGU annual leadership award

A Texas A&M University administrator has been presented the prestigious Ocean Sciences Award by the American Geophysical Union in recognition for his 25 years of service and leadership to the ocean science community.

Feenan Jennings, director of the Texas A&M Sea Grant College Program, was given the award at the AGU's annual meeting. The AGU is a non-profit organization of more than 16,000 members dedicated to promoting the scientific study of the earth and fostering cooperation among the geophysical disciplines.

In presenting the award, officials of the AGU noted that Jennings' long career in marine research began when he left his position as senior engineer at the Scripps Institution of Oceanography in 1958 to become head oceanographer of the Geophysics Branch of the Office of Naval Research. In 1966 he was named deputy director of the Ocean Science and Technology Division.

Jennings then joined the National Science Foundation as head of the Office for the International Decade of Ocean Exploration. In 1978 he was named director of the Texas A&M University Sea Grant College Program, one of the nation's largest Sea Grant programs.

At a time when the Middle East looks even less stable than ever, two former antagonists are cooperating in a multi-million-dollar marine research program — the first of its kind.

Middle East marine study benefits Egypt and Israel

Scientists from Egypt, Israel and the United States recently learned that \$1 million in federal funding has been approved to continue research by the three nations on Mediterranean coastal management, seafood resources and aquaculture.

Another \$1.7 million has been pledged toward two additional years of study, says Texas A&M University oceanographer, Dr. Sayed El-Sayed, chief scientist on the project.

The research effort is supported by the Agency for International Development, and is the only program in which Israel and Egypt are sharing scientific information.

Aside from supporting the Middle East peace process by increasing contact between Egyptian and Israeli scientists, sponsors say the research will be beneficial to both countries

Upcoming marine-related meeting schedule given

Several conferences on marine-related topics are scheduled for the upcoming months. Some are listed here.

March 19-23—*2nd International Seminar on the Offshore Mineral Resources*, Brest, France. Contact Louis Galtier, Association Germinal, B.P. 6009, 45060 Orleans Cedex, France, (38) 63-80-01.

March 29-April 1—*Texas Shrimp Association Annual Convention*, Lass Vegas. Contact Texas Shrimp Association, 403 Vaughn Bldg., Austin, Texas 78701, (512) 476-8446.

April 3-5—*Water for the 21st Century: Will It Be There?*, Dallas, Texas. Contact Dr. Michael A. Collins, Conference Chairman, School of Engineering and Applied Science, Southern Methodist University, Dallas, Texas 75275.

June 6-8—*4th Coastal Marsh and Estuary Management Symposium*, Baton Rouge, La. Contact Phillip J. Zwank, Room 212, Forestry Bldg., Louisiana State University, Baton Rouge, La. 70803, (504) 389-0404. ■

MARINE ADVISOR

BY RITA ARNOLD

Federal offshore waters stay closed to shrimpers

Closure of the shrimp fishery in federal waters off the coast of Texas will remain intact for the 1984 fishing season, according to Jack T. Brawner, director of the National Marine Fisheries Service's (NMFS) Southeast Region. The Gulf of Mexico Fishery Management Council recommended closure be retained after hearing an analysis by the NMFS Southeast Fisheries Center that described the impacts of the 1981-1983 closures as beneficial.

NMFS' analysis indicated the combined seasonal closure in federal and state waters resulted in increases in pounds of shrimp landed, revenues generated and average size of shrimp landed. The estimated benefit of combined closures in 1981 was 8.9 million pounds or \$54.5 million. The 1982 benefit was 4.2 million pounds or \$41.3 million. Benefits for 1983 have not yet been calculated.

Promoting Texas oysters focus of special program

Texas may soon have an oyster trade association. A handful of the state's growers and dealers met in December to discuss forming an association that could help garner a "premium" reputation for the state's oysters.

A committee has been formed to look into articles of incorporation and goals for the group. Members include: Morris Sadler and Clifford Hillman, Hillman Shrimp and Oyster Company, Galveston; Arthur Hulst, Henry's Seafood, Seabrook; Hugh Harris, Coastal Seafood, Inc.; Fulton; and Joe Nelson, Fishermen's Harvest, Anahuac.

The initial meeting, "Promoting the Texas Oyster," was sponsored by the Texas A&M Marine Advisory Service. Russell Miget, marine fisheries specialist, discussed oyster survival and Mike Haby, seafood marketing specialist, talked about the potential Texas oysters have to compete in the half-shell trade and the possibility of developing an industry-oriented quality assurance program.

Drunk boater bill under close Washington review

Federal legislation has been introduced that would make operating a boat while intoxicated a federal crime, punishable by a fine of up to \$5,000 and a year in jail.

The bill, introduced by Rep. Gerry E. Studds (D-MA) in November and cosponsored by Representatives Walter Jones (D-NC), Edwin Forsythe (R-NJ) and Don Young (R-AK), was sent to the Coast Guard Subcommittee. It has also been incorporated into the Coast Guard reauthorization bill that would authorize funds for the Coast Guard through 1986. Hearings are being held on that bill now.

According to a subcommittee staff member, a questionnaire went out to states asking for comments on the alcohol bill. Of 31 states responding, 26 supported the idea.

The bill would also require that all boating accident reports include a statement as to whether alcohol abuse was a cause of the accident and would mandate inclusion of information about the hazards of operating a vessel while under the influence, in all federally supported state boater education programs.

Toll-free number assisting boaters in handling skills

A nationwide, toll-free hotline — 800-336-BOAT — is providing boatowners with listings of boating safety education courses offered locally. Listings include courses given by the U.S. Power Squadron, the Coast Guard Auxiliary and the American Red Cross.

Initiated January 2, the service is operated by the Boat Owners Association of the Foundation for Boating Safety. Callers are given course dates and/or a local name and phone number to contact for further information.

Babies are new consumers of seafood test products

Babies may soon be seafood lovers too, according to a report in Coastwatch, a newsletter published by the North Carolina Sea Grant College Program. A master's candidate in food sciences at North Carolina State University, Laura J. MacKintosh, has completed initial research that will develop baby food made out of seafood. Her work is funded by North Carolina Sea Grant and the National Fisheries Institute.

Currently no baby foods use fish as a main ingredient, but MacKintosh has already developed a meat stick for toddlers using minced sea trout. The product has proved acceptable in nutritional, textural and sensory tests. She is working on fish chowders and meat dinners for toddlers too, with strained versions for infants. Final results of her project will be presented in August at the Atlantic Fisheries Technological Conference.

Public hearing on shrimp management scheduled

The Texas interim subcommittee on shrimp management was to hold its first public hearing March 7, at the Texas A&M University campus in Galveston. Between 75 and 100 notices were sent out about the meeting to a mailing list developed from witnesses at last year's legislative hearings on bills on shrimping or commercial fishing.

Among those expected to attend were representatives from Gulf and bay shrimping associations, the Gulf Coast Conservation Association, the Texas Parks and Wildlife Department, the National Marine Fisheries Service, the Gulf Coast Fisheries Management Council, the Texas Coastal and Marine Council, as well as individual commercial shrimpers and fishermen.

Subcommittee members are gathering testimony regarding possible changes needed in the Texas Parks and Wildlife Code that deals with shrimping.

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.

Sea Grant Program

Making the Most of the Marine Environment. Rita Arnold. 16 pages, six photographs, one map. Single copies are free. TAMU-SG-84-503.

What is the Texas Marine Advisory Service and how does it work? This 4 x 9-inch, 16-page brochure briefly describes MAS' purpose and its history in Texas. It outlines the jobs of marine agents and specialists. The brochure includes a list of the addresses and phone numbers of MAS personnel in Texas and a map showing their office locations.

Seafood Preparation

Shrimp Treats from the Ladies of the Fleet. Annette Reddel Hegen. 4-panel brochure. TAMU-SG-84-501.

Seven delicious ways to fix Texas shrimp! These recipes were gathered from members of the Texas Shrimp Association Auxiliary, whose families have been in the shrimp industry for years. Included are recipes for sea surprise, a molded shrimp salad; shrimp and eggplant dressing; shrimp and buttery pasta; barbecued shrimp; shrimp ball hors d'oeuvres; Cantonese shrimp; and crispy fried shrimp dipped in a batter of Cream of Wheat cereal.

Fisheries

The Commercial Production of Mudminnows (*Fundulus grandis*) for Live Bait: A Preliminary Economic Analysis. Benita P. Waas, Kirk Strawn, Michael Johns and Wade Griffin. In Texas J. Sci. XXXV(1):51-60. 100 pages, 4 tables, 1 figure. \$1. TAMU-SG-83-820.

Seasonal Occurrence of Black Drum, *Pogonias cromis*, and Red Drum, *Sciaenops ocellatus*, off Texas. Jeffrey L. Ross, John S. Pavela and Mark E. Chitenden, Jr. In Northeast Gulf Science 6(1):67-70. 4 pages, 2 tables, 1 figure. \$1. TAMU-SG-84-802.

The Texas Shrimp Fishery: Analysis of Six Management Alternatives Using the General Bioeconomic Fishery Simulation Model. W. Griffin, J. Warren, J. Nichols, W. Grant, C. Pardy. 66 pages, 20 tables, 9 figures. \$3. TAMU-SG-84-202.

Six alternatives for managing the Texas shrimp fishery, proposed in recent fishery management plans or legislation, are analyzed with the General Bioeconomic Fishery Simulation Model. Alternatives consist of closure of specified areas for particular periods of time, changes in count size regulations, or both. They are evaluated in terms of their impact on total landings, amount of discards, cost and returns, and fishing effort. Impacts are estimated for the first year and for a long-run situation giving the industry time to adjust by increasing or decreasing the number of bay boats and Gulf vessels.

Cutting Fuel Costs: Alternatives for Commercial Fishermen. Dewayne Hollin and Steven R. Windh. 17 pages, 2 charts, 2 graphs, 9 illustrations. Single copy free. TAMU-SG-84-504.

If you're looking for ways to reduce fuel consumption or increase fuel efficiency, this publication is a place to start. It describes 14 alternatives for commercial fishermen, including short-term maintenance measures and long-term alternatives such as management aids, devices to improve engine performance and vessel modifications.

Mariculture

Developing a Selective Breeding Program for Penaeid Shrimp Mariculture. L. James Lester. In Aquaculture 33(1983):41-50. 10 pages, 4 tables, 1 figure. \$1. TAMU-SG--833-804.

Keep That Bait Alive! William Younger and Russell Miget. 12-panel brochure; 6 figures, 2 charts. Single copy free. TAMU-SG-83-506.

Coastal fishermen have found that keeping bait alive is one of the keys to successful saltwater bait fishing. This brochure describes the physical needs of saltwater baits and explains conditions to avoid. The brochure opens into a poster depicting bait systems that can be bought or built including flow-through buckets, sprayers, aerators and live bait wells. Advantages and disadvantages of each are listed. A brief guide to handling and hooking is included along with a chart of commonly used live saltwater baits.

Effects of Ammonia and Nitrate on Growth and Survival of Red Drum Eggs and Larvae. G. Joan Holt and C.R. Arnold. In Trans. Am. Fish. Soc. 112:314-318. 5 pages, 2 tables, 2 figures. \$1. TAMU-SG-83-818.

Recreation

A Statewide Survey of Boatowners in Texas and Their Saltwater Fishing Activity. Robert Dittonn and Anthony Fedler. 65 pages, 15 tables, 3 figures. \$2. TAMU-SG-83-205.

Data on saltwater fishing patterns of Texas pleasure boatowners were investigated through a survey of registered boatowners in the state. A sample of boatowners was interviewed by telephone, and when saltwater boat fishermen were identified, they were mailed a questionnaire. The total usable response rate was 66 percent. Sample findings were extrapolated to the statewide population of boatowners.

More than 60 percent of the registered boatowners in Texas used their boats for fishing during the study year. However, only 14 percent of all Texas boatowners (approximately 529,000) fished salt water (bays or offshore). Approximately three percent (16,000) of Texas boatowners accounted for more than 120,000 fishing trips in the U.S. Territorial Sea and the Fishery Conservation Zone.

The Galveston Bay area, with almost one-half of all bay boat fishing activity and more than one-third of all offshore fishing activity, was identified as the state's center of marine recreational boat-fishing. Port Aransas was the second leading offshore recreational fishing port, with almost 25 percent of all offshore trips.

Ocean Engineering

The Economic Viability of Four-Metal Pioneer Deep Ocean Mining Venture. B.V. Andrews, J.E. Flipse, F.C. Brown. 201 pages, 43 tables, 27 figures. \$5 for single copy. TAMU-SG-84-201.

A pioneer vertically integrated deep ocean mining venture is described which explores for and transports manganese nodules, processes them into four metals and markets the products. The system is defined, and capital and operating costs are estimated in 1982 U.S. dollars. A basic return-on-investment or payout analysis model is presented and used to evaluate the financial returns of the project.



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