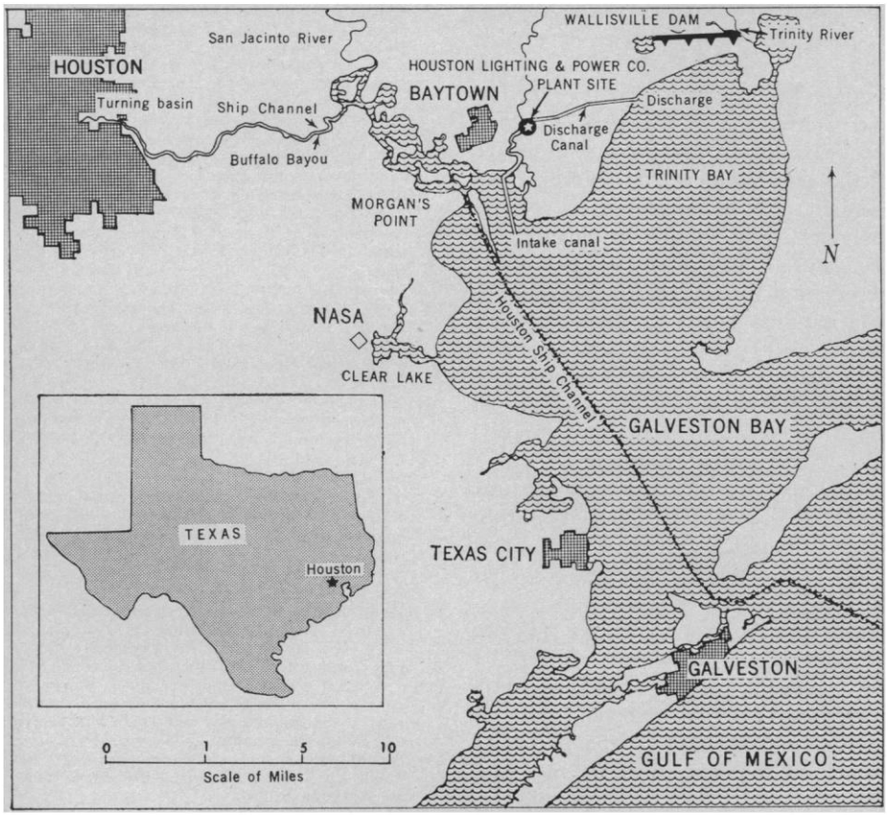

Galveston Bay: Test Case of an Estuary in Crisis

For the environmentalist in search of horror stories, Galveston Bay, now beset by an astonishing variety of problems, is a good place to look. In fact, for the second time in 2½ years members of the President's Water Pollution Control Advisory Board last month toured the bay system and expressed dismay at what they found. Nowhere are the problems of pollution control and environmental management more frustrating and complex than here on this important Gulf Coast estuary, now threatened with the loss of its valuable fishery and recreational resources.

As is true of most environmental problems elsewhere, a factor contributing to the problems of Galveston Bay has been the rapid growth of population and industrial activity in the surrounding area. This growth, which has created vast new demands on water supplies and waste disposal facilities, has been rivaled in Texas only by that in the Dallas–Fort Worth region. Galveston and Texas City, at the mouth of the bay, together have some 115,000 people, and their commercial and industrial activities (such as the complex of oil refineries and chemical plants at Texas City) are significant. But the big growth, of course, has taken place in and around Houston, which sprawls over the flat coastal prairie near the head of the bay.

A major event in the history of Houston and the bay area was the construction of the Houston Ship Channel in 1914, which allowed ocean-going vessels to pass through the bay and continue up Buffalo Bayou to the turning basin in Houston, 50 miles from the Gulf of Mexico. The Ship Channel was to make Houston a major port, now surpassed in total tonnages handled by only two other U.S. ports, New York and New Orleans. Moreover, land along the Ship Channel and Buffalo Bayou was to become prime industrial property, especially attractive to oil companies seeking refinery sites near the Texas oil fields and handy to major shipping lanes. Today, the Ship Channel is lined with refineries, chemical and petrochemical plants, fertilizer factories, gypsum and cement plants, a steel mill, and other industrial facilities. This industrial growth has helped to push the population of the Houston metropolitan area to nearly 2 million, or about three times what is was 30 years ago.

Consider for a moment Galveston Bay as it is and as it used to be. Extending over 533 square miles, the bay is the largest of the estuaries on the Texas coast. The bay still supports major commercial and sports fisheries, and oysters, shrimp, crabs, and redfish, sea trout, and other finfish are plentiful. However, nearly half of the bay is now closed to oyster harvesting because of pollution, although fortunately the most productive oyster reefs are in waters still open to harvesting. Fishery biologists are worried that, given the degradation and numerous man-made changes in the bay environment, the bay's productivity for marine life will decline. And, since the bay is an important nursery for shrimp and certain fish (such as croakers, anchovies, and menhaden) which spend part of their life cycle in the Gulf of Mexico, conditions that hurt fishing in the bay will hurt fishing in the Gulf also.

Like other estuaries, Galveston Bay is a brackish body of water which, in general, becomes less salty toward the head of the bay where there is an inflow of fresh water from tributaries. For oysters brackish water is essential, as they can survive in neither fresh water nor seawater. The juvenile forms of shrimp and finfish such as menhaden also require brackish water, although these species do best in the lower salinities found near the head of the bay. The bay waters are enriched by nutrients brought in by the tributaries or flushed out of the shallows and marshes by tidal action, and this too helps to account for the abundance of marine life which this estuary supports.

Fifty years ago perhaps nearly a fifth of the bay bottom was covered by exposed oyster shell, much of it lying in extensive semifossilized shell reefs. Representative Bob Eckhardt, Democratic congressman from Houston

and long a crusader for protection of the bay, has described these reefs: "[They] are like a miniature mountain range under water. Their sluices and ridges provide a nursery ground for myriads of marine organisms. This minute marine life, in turn, provides food for the next cycle of life in the bay, the shrimp and the smaller fishes. The shrimp and the small fishes then provide food for the large fish, the game species such as the channel bass and the spotted sea trout. . . ."

Radical Changes

The bay environment has experienced, and is still undergoing, radical changes. Consider the following:

- *Shelldredging.* Shelldredgers have removed most of the shell from the bay, often taking exposed shell as well as shell underlying a heavy layer of silt. Shell is valuable in highway construction and for other uses (as in the manufacture of cement), and from it fortunes have been made. The U.S. Army Corps of Engineers has moved finally to protect major reefs that are still left and state authorities have tightened their own formerly inadequate regulations for protection of reefs. Little shelldredging is now being done, but until recently, the dredges were taking millions of cubic yards of shell from the bay each year. Not only were shell reefs destroyed but in some cases the dredging and washing of shell caused the silting up of parts of reefs bearing live oysters.
- *Water diversions.* Livingston Reservoir, which has just been built on the Trinity River (the largest of the bay's tributaries) by the City of Houston and the Trinity River Authority, will store water largely for diversion to Houston. Its effect on the bay will be twofold: first, the flow of fresh water into the bay will be reduced, salinities will be increased, and the production of shrimp, oysters, and other marine life may be hurt; second, while most of the water diverted to Houston will later be returned by way of the Ship Channel, it will return in a used—and polluted—condition. The San Jacinto River (the bay's second largest tributary) was dammed by the City of Houston in 1954, and now, except during periods of high flow, most of its water is used by the city and discharged as waste water into the Ship Channel.

Still other diversions may be in the offing. A $752-million navigation project would open up the Trinity River to barge traffic all the way to Dallas and Fort Worth, some 360 miles by river from the bay, and further reduce flows of fresh water into the bay. This project has been authorized by Congress, and $150,000 for advanced planning has been appropriated. An even more ambitious proposal, known as the Texas Water Plan, calls for the construction (as part of a multibillion-dollar program to meet water needs throughout the state) of a 400-mile canal just inland from the Gulf of Mexico, to link together all major rivers flowing into the Gulf. The Water Plan, still being promoted by the Texas Water Development Board despite its rejection in a referendum last November, is supposed to provide for an ample flow of water into the estuaries but many people fear that the estuaries would be shortchanged during times of water scarcity.

- *Loss of marshlands.* The Wallisville Dam, a project of the U.S. Army Corps of Engineers, is being built on the Trinity River about 4 miles upstream from where it enters Trinity Bay, which is a part of Galveston Bay. Primarily, the purpose of the dam is to open the lower river to navigation and to keep salt water from intruding upstream to the intakes of water supply and irrigation systems. Because the dam has little storage capacity, the project will never substantially reduce the flow of fresh water into the bay. But it is eliminating 20,000 acres of brackish ponds, sloughs, marshes, and bottomland, nearly all of which biologists of the U.S. Fish and Wildlife Service regard as prime shrimp and finfish nursery grounds with an annual productive capacity of not less than $300 an acre and probably more.

Benefits Less Than Costs

The biologists' estimates, which are not based on field studies, are disputed by the Corps of Engineers. But if the estimates are correct, or even if they are not more than 80 percent wrong, the annual cost of the Wallisville project—in terms of lost fishery resources alone—will be larger than the benefits. And the cost referred to here does not take into account either the possible decline in the productivity of the bay fishery caused by the loss of nutrients from the Trinity River marshes to be impounded or the loss of the excellent waterfowl habitat which these marshes afford. The dam could have been built farther upstream in order to avoid, or at least mitigate, the loss of resources that are peculiar to the tidal marshes.

- *Pollution.* The Houston Ship Channel, or that part of it which follows Buffalo Bayou from Houston to Galveston Bay (a distance of about 25 miles), ranks as one of the filthiest stretches of water in the United States, especially at its upper end. Roy W. Hann, Jr., a professor of environmental engineering at Texas A & M University, who has made some 180 trips on the channel gathering data on its condition, says that industrial pollutants and huge volumes of poorly treated domestic sewage from Houston and its suburbs are imposing on the channel a daily waste load that is the equivalent of the raw sewage of a city of 2 to 3 million people. Often, dissolved oxygen is totally lacking in much of the channel.

According to Hann, the major polluters include firms such as Diamond Alkali Corporation, Shell Chemical Corporation, Sinclair Refining Company, Signal Oil Company, Humble Oil and Refining Company, and U.S. Plywood-Champion Papers, Inc. The channel would remain polluted for years even if all effluents were cleaned up tomorrow, for its bottom is covered by a 2-foot-thick blanket of putrid sludge. On their recent tour of the bay system, members of the President's Advisory Board were appalled to see ships actually churning up oil from this sludge.

Bad as the pollution in the Ship Channel is, it would be more tolerable if it were not endangering Galveston Bay. Wastes from the Ship Channel are by far the bay's worst pollution problem, although it has other pollution sources such as the City of Galveston which is discharging 1.5 million gallons of raw sewage into bay waters each day.

Still other alterations of the bay environment are occurring, for example, the filling in of some marshland in the Galveston area to provide waterfront sites for housing developments. And the Houston Lighting and Power Company (HLP) is well along with a project that is far-reaching in its possible environmental implications. Next year HLP will complete construction of the first 750,000-kilowatt unit of its 1.5-million-kilowatt, gas-fired generating plant on Cedar Bayou. The site is just east of Baytown on the peninsula separating the northwest part of the bay from Trinity Bay and is several miles north of a large rolling mill being constructed along the bayou

NEWS IN BRIEF

• **CBW**: The Florida White House announced on 14 February that President Nixon has banned production and use of toxins for germ warfare purposes. The President's decision ends a controversy over whether toxins should be included in his earlier ban on biological weapons. Toxins are chemicals that are produced by biological organisms and they thus fall somewhere between chemical and biological weapons. The Administration has estimated that a chemical means for producing toxins could be developed within 5 years, but Nixon decided to ban all toxins regardless of their origin. Nixon's order requires the destruction of all toxin stocks except those needed for "defensive research," such as research on immunization techniques. A high administration official said the Pine Bluff, Arkansas, biological warfare center will no longer be required for classified work and might possibly be used for civilian health research.

• **HERBICIDE EFFECTS ASSESSMENT COMMISSION DIRECTOR**: Arthur J. Westing, associate professor of botany and chairman of the biology department at Windham College in Vermont, has been appointed director of the AAAS Herbicide Effects Assessment Commission. Matthew S. Meselson, a Harvard biologist named by AAAS to plan a study of the effects of defoliants and herbicides used in South Vietnam, appointed Westing to direct the project. Westing will coordinate the work of several scientific specialists in order to prepare a detailed plan to investigate the long-term effects of these chemicals on the ecology and on human welfare in Vietnam.

• **POLLUTION AT FEDERAL FACILITIES**: Declaring that the federal government has become one of the nation's worst polluters, President Nixon has issued an Executive Order requiring federal facilities to conform with air and water quality standards established under federal law. The order establishes a $359-million program for achieving this objective, prohibits the transfer of these funds to other programs, requires that new facilities be pollution-free, and gives responsibility for enforcement of the order to the secretaries of Interior and Health, Education, and Welfare.

• **DADDARIO SEEKS GOVERNORSHIP**: Representative Emilio Daddario (D–Conn.), who is considered one of the strongest congressional supporters of science, has announced his candidacy for the governorship of Connecticut after 12 years in Congress. Daddario is a member of the House Committee on Science and Astronautics, and chairman of its Subcommitee on Science, Research, and Development, which oversees the budget of the National Science Foundation.

• **FLORIDA JETPORT**: An agreement between state, local, and federal officials seems to have ruled out completion of a jetport near the Everglades National Park. An alternative site in southern Florida will be sought; the partially finished facilities at the original site will be used for training purposes, and only until another site can be found. Interior Secretary Walter Hickel and Transportation Secretary John Volpe, in making the announcement, cited as the major motivation for the agreement a concern for the ecological stability of the area. Subsequently, two Floridans have filed suit to stop use of the training airstrip, contending that even limited use of the facilities will injure the Everglades.

• **JAPANESE SATELLITE**: Japan has become the fourth nation in the world —after Russia, the United States and France—to orbit its own satellite with its own rocket. On 11 February, following a series of frustrating failures, Tokyo University scientists successfully launched a 51-pound, 18-inch-wide scientific satellite using a solid-fuel rocket without sophisticated guidance mechanisms. The satellite stopped transmitting a few hours after launch, apparently because of battery failure.

• **U.N. ENVIRONMENT CONGRESS**: Stockholm has been chosen as the site of the U.N. Environment Congress in June 1972. The conference was conceived as a means to stimulate and to provide guidelines for action by national governments and international organizations to solve environmental problems. United Nations Secretary-General U Thant, government delegations, scientists, educators, writers, and the press are among those expected to attend the 2-week conference.

by the U.S. Steel Company. Originally, HLP had planned to draw up to nearly 1 billion gallons of cooling water a day directly from the Houston Ship Channel, running this highly polluted water through the plant and then discharging it into the relatively clean waters of Trinity Bay.

Conservation groups were outraged, and HLP, fearing that the Corps of Engineers might withhold the permit required, modified the plan by routing the cooling water intake system away from the Ship Channel. Nevertheless, the U.S. Department of the Interior, in a report prepared in 1968 by its southwest regional office, has expressed concern, that, by comparison with the waters of Trinity Bay, the cooling water discharged from the plant will be more polluted, of higher salinity, and from 7° to 12°F warmer. The effect on marine life will be bad and perhaps disastrous, the report indicates. Although HLP says these fears are groundless, the test will come when the new plant begins operating.

(HLP hopes to build additional generating units at the Cedar Bayou site and, in anticipation of possible objections from regulatory agencies, it is now seeking means to avoid thermal pollution altogether. There are but two possible solutions: a closed, recycling cooling system with evaporative cooling towers or a large cooling pond through which water from the plant would be circulated before its discharge into Trinity Bay.)

Even the changes to the bay environment which HLP will cause could be dwarfed by those that might follow construction of a hurricane levee the Corps of Engineers proposes to build at or near the entrance to Galveston Bay. This latter project, which is still in the conceptual stage, could alter the entire natural regime of the bay and concentrate pollutants in the bay's middle and upper reaches, although the Army engineers are making model studies in order to design a project that would not have such effects.

The channel dredging, shelldredging, water diversions, flooding of marshes, pollution—these all represent large-scale and often heedless or inadvertent modification of the Galveston Bay environment. While rapid population and economic growth have made environmental change inevitable, hurtful effects on the bay could have been mitigated and in some cases avoided were it not for the following: first, too little has been known about the bay, and those

exploiting or changing it generally have failed to think of it as a complex natural system; second, a dominant political conservatism, highly protective of industrial interests, has kept the state government from dealing effectively with polluters; and, third, the public works, pollution control, and regulatory functions relevant to the bay environment have been dispersed among a bewildering assortment of state, local, and federal agencies, often without effective coordination.

Had Galveston Bay been thought of as a *system* of interrelated parts and functions, the state surely would not, for example, have allowed shelldredgers, in 1963, to begin dredging within 300 feet of live oyster reefs (the previous limit having been 1500 feet) when no significant study of the siltation caused by dredging had been made. And the Water Quality Board presumably would not have assumed that the upper part of the Ship Channel, near Houston, could be so heavily used for waste disposal without affecting the rest of the bay—an illuminating case (of which more will be said shortly) that has involved soft regulation as well as insensitivity to the nature of the bay system.

The state's failure to do more to protect Galveston Bay and its other water resources reveals remarkable inconsistencies in its policies. Texas is a semiarid state and water is precious; as early as the 1930's, long before most other states took similar action, it required primary and secondary treatment of municipal wastes. Yet, as recently as 1967, the Water Pollution Control Board (since renamed the Water Quality Board) had a minuscule budget and only 4 full-time employees of its own. Even today, the board has only 40 enforcement officers for the entire state, which is larger than all of Illinois, Indiana, Iowa, Wisconsin, and Michigan combined.

In the Galveston Bay area, where many people suffer from unclean air and are offended by polluted water, environmental quality is an important political issue. But statewide, this has not been true. According to Congressman Eckhardt of Houston, who has built his political career by battling polluters and shelldredgers, Texas would have done more about the problems of the bay area if state legislators from the piney woods, the cow country, and the panhandle had been more willing to appropriate money for pollution control programs. And, too often, Eckhardt says, when stronger enforcement measures have been proposed, such legislators have been won over by the counterarguments and the highball and thick steak offered by industry lobbyists.

The situation that has existed in the Houston Ship Channel and the convoluted regulatory policies governing it offer ample evidence of the clout industrialists have in Texas politics. The problems of the Ship Channel take on still broader significance from the fact that the water quality standards for all the interstate and tidal waters within Texas, including the waters of the channel, have been fully approved by the U.S. Department of the Interior. These standards, as defined by Interior's Water Pollution Control Administration (FWPCA), are supposed to include not only water quality parameters for various channel segments or zones but, also, firm schedules by which industries and municipalities are to clean up their effluents and plans for the enforcement of these schedules.

Walter A. Quebedeaux, Jr., the Harris County (Houston) air and water

Nixon Offers Environmental Program

President Nixon, who recently has been talking a lot about environmental quality, last week sent to Congress what seemed generally to be a set of strong proposals for dealing with some major environmental problems. In fact, although coming from a president who has deplored growth in the size and power of the federal bureaucracy throughout most of his political career, these proposals would significantly extend Washington's reach in matters of pollution control. Some of them might have had little chance of enactment even a year ago, when the environmental quality issue had not yet come to the forefront of public attention.

The President has, for instance, proposed stronger federal powers of enforcement (and less circuitous procedures) in water pollution cases where state authorities have failed to act. Also, he has asked that the federal pollution control program be extended to include *all* navigable waters, intrastate as well as interstate. His proposal to obligate $4 billion over the next 4 years for construction of sewage treatment facilities, while smaller than what Senator Edmund Muskie (D-Maine) has proposed, would nevertheless be a large commitment.

The President also has asked for extensions of federal power with respect to air pollution control, and he even wants to establish nationwide air quality standards, rather than to have the present effort to establish regional standards continue. As for control of solid wastes, the President's initiatives are limited; but he has offered an imaginative proposal to establish a program of bounty payments for junk automobiles brought in for scrapping. And, as one step toward providing more public recreation areas, the President has directed that agencies review their land holdings to see whether some lands should not be converted to park and recreation use. Some fundamental environmental problems, such as those of urban sprawl and population growth, were not mentioned in the President's environmental message.

The President's environmental message, containing his proposals, was discussed with the press by a panel of officials headed by Russell Train, chairman of the newly appointed Council on Environmental Quality. At the moment, Train is playing an influential and increasingly visible role in environmental policy matters.

Many of the President's legislative proposals will be taken up soon in hearings conducted by Senator Muskie, chairman of the Senate Air and Water Pollution Subcommittee and possibly Nixon's rival for the Presidency in 1972. A number of the proposals are similar to those that Muskie recently advanced. Some, such as the one for the adoption of national air quality standards, call for new approaches. And, in general, the President is trying to make do with substantially smaller financial outlays than those Muskie is proposing. The environment has its politics as well as its problems, and two shrewd and able politicians, with conflicting ambitions, are vying to be its chief defender.—L.J.C.

pollution control officer, believes that, by fixing unduly permissive water quality parameters for that part of the Ship Channel in and approaching Houston, the Water Quality Board has guaranteed the continued pollution of Galveston Bay. His opinion is one which the available evidence seems to bear out. Where the Ship Channel passes through the lower part of Buffalo Bayou, near the bay, its waters are classified for support of fish life as well as for navigation and industrial uses. But, for the waters farther up the bayou, the classification does not include support of marine life, and some of the critical water quality parameters fixed for those waters are correspondingly lower. For example, at the turning basin in Houston, where the Ship Channel ends, the requirement for dissolved oxygen is fixed at 1.5 parts per million, which is not much more than what can be found in an open sewer.

30,000 Dead Fish

"You can't divide up the Ship Channel that way," says Quebedeaux. A heavy rain in Houston, he explains, flushes great slugs of polluted water from the upper part of the Ship Channel into the lower part, often producing fish kills. The last large kill, of 30,000 fish, occurred at Morgan's Point in September 1968, but smaller kills occurred last year at Baytown. Fish kills have at times literally driven people from their waterfront homes, causing them to take refuge temporarily in motels until the stench of decaying fish has diminished.

But even though the water quality standards for the upper part of the Ship Channel appear grossly inadequate, the industries on this part of the channel hold permits which, by the Water Quality Board's own admission, allow waste discharges of such low quality that these standards cannot be met. Furthermore, lenient as they are, the conditions of the permits are being violated by many Ship Channel industries, although Water Quality Board spokesmen claim that nearly all discharges will be brought into compliance with the permits by some time in 1971 as the industries complete construction of costly new treatment facilities. But there are no fixed deadlines for completion of this work, and *no* permit has ever been revoked. And the policy of the board has been not to revise and upgrade effluent permits until after the completion, in 1971, of a study of the channel's waste assimilative capacity.

Wide diffusion of authority among various local, state, and federal agencies responsible for using and protecting bay resources clearly has created major problems. At the local level, city and suburban governments and water districts are running their own water supply and sewage collection and treatment systems. Some 190 municipal sewage treatment plants, most of them overloaded or inefficiently run (or both), are discharging effluents into the bay system. And these local governments are just beginning to think of regional land-use zoning, although, as pressures of population and economic growth continue to mount, there is a critical need for such zoning to protect the bay from dredging and landfill operations and other harmful activities.

At the state level, the agencies responsible for the use or protection of Galveston Bay and its tributaries include, besides the Water Quality Board, the Parks and Wildlife Department (responsible for shelldredging and pollution problems affecting wildlife), the Department of Health (responsible for determining whether shellfish are safe for harvesting), the Texas Water Development Board, and even the Texas Railroad Commission. This latter agency, which regulates the oil and gas industry, several years ago was given jurisdiction over pollution caused by that industry after the Water Pollution Control Board began showing an interest in pollution from oil field brines. Four of the seven seats on the Water Quality Board are occupied by ex officio members representing the other agencies just mentioned but little visible good has come from this attempt at coordination.

Conspicuous failures of interagency coordination have occurred in the past among federal agencies responsible for protecting the bay. For instance, if the Wallisville Dam project does in fact wipe out highly valuable marine fishery resources, this will result in part from the failure of the Corps of Engineers to obtain competent field studies from the Fish and Wildlife Service before designing the project and from the failure of this latter agency to conduct such studies. Now, however, interagency collaboration seems to be becoming more effective. For example, in placing restrictions on the shelldredgers and in studying the environmental implications of the proposed hurricane levee, the Corps of Engineers is working closely with the Fish and Wildlife Service and the FWPCA.

Although the hour is late, all of the basic problems of the bay environment are under attack and there are in fact signs of progress. The Water Quality Board has had under way since 1967 a $3.5-million Galveston Bay Study, involving an investigation of population and economic growth patterns and land-use questions as well as the gathering and analysis of physical and biological data. The study, to be completed in 1971, will provide a better basis on which to design strategies for protection of the bay. For example, the study might indicate that, regardless of the level of treatment given the wastes it receives, the Ship Channel will have to be aerated mechanically to increase its assimilative capacity.

Another encouraging sign is that politicians in Texas, like those elsewhere, are beginning to speak of the environment in the same respectful way in which they speak of mother and the flag. Last year, the legislature even passed a measure sponsored by Houston legislators making corporate polluters liable to criminal prosecution. The most startling change, however, is the tough talk beginning to come from the Water Quality Board, a body which from its inception has been highly sensitive to the state's political mood.

Board Demands "Second Effort"

The board's new chairman, Gordon Fulcher, a newspaper publisher from Atlanta, Texas, recently told *Science* that hearings will be held soon on pollution problems in the bay area to determine whether industries are complying with their effluent permits and whether those permits should be revised. "The board wants a second effort," Fulcher said. Furthermore, the board is for the first time demanding periodic reports from industry on the quality of effluents—a policy innovation that should assist the Galveston Bay Study group which has been reduced to obtaining such information by promising the Ship Channel industries that the data will not be identified with specific plants and will never be used for enforcement purposes.

Recently, the board initiated legal action against several small municipalities and water districts which are polluting Clear Lake, an embayment off of Galveston Bay near the Manned Spacecraft Center. And Fulcher even speaks matter-of-factly about the pos-

sibility of a showdown with Houston, the state's largest and most politically potent city. Houston has spent about $75 million over the past 6 years on improving its sewage collection and treatment facilities, but this improvement effort was retarded in 1968 by the voters' rejection of two large public works bond issues.

To catch up with the need for sewage facilities the city must spend perhaps as much as another $100 million, and, should the voters not approve the new bond issue currently proposed, a crisis may ensue. Fulcher observes that, if Houston or any other city refuses to clean up its domestic wastes, the board will seek a court order requiring such action and raising sewer service charges sufficiently to pay for it. "We will do whatever it takes," he says. The legislature, he adds, should assist the cleanup by appropriating money for state treatment facility grants, without which Houston and other localities have been unable to qualify for the maximum federal grants.

The Water Quality Board will be in a stronger political position to deal with recalcitrant municipalities and industries if Texans know that the failure of the state to accomplish a cleanup will only mean that federal authorities will come in and do the job. FWPCA will be able to play this supporting role better if Congress goes along with the proposals made last week by President Nixon—and made earlier by Senator Edmund Muskie of Maine—to broaden the agency's powers.

The President asked that FWPCA be given authority to approve or reject state quality standards for effluents as well as for receiving waters; and, further, that it be authorized to initiate enforcement actions even in situations where, as in the case of the Galveston Bay system, no interstate waters are in-

NASA: Further Cuts in University Support Spending

The National Aeronautics and Space Administration last week called in university administrators to explain how cuts in the space agency budget will not only slow the pace of the space program but also the education of space scientists.

The most dramatic cut in university support is the termination of the Sustaining University Program (SUP). At its peak in 1966, this program gave $45 million to about 175 colleges and universities for R&D and training. Now the $7-million program of 1970 will be terminated in fiscal 1971, which begins 1 July (see Table 1).

A total of $21 million will be cut by NASA in contracts and grants to universities. The cuts are distributed across the offices of NASA, but the chief target seems to be graduate training, with the justification that fewer scientists will be needed in the future.

The cuts in SUP will eliminate more than 200 predoctoral training grants, which had been funded at $4.18 million. Other graduate students, researchers, and even whole space science departments had been supported on many campuses through grants for multidisciplinary research; this funding will also end.

The students will not be cut off immediately, however. The SUP grants have been step-funded, so that an individual grant will be reduced by steps over 3 years.

F. B. Smith, assistant administrator for university affairs at NASA, held out the possibility that other agencies could take over the funding of some of the grants, since university R&D funding in the total federal budget will increase by $114 million in 1971.

Table 1. NASA obligations to universities. Figures are expressed in millions of dollars.

	Office of Space Science and Applications	Office of Advanced Research and Technology	Office of Manned Space Flight	Sustaining University Program	Other	Total
1969	56	23	36	9	6	130
1970 (est)	48	19	33	7	4	111
1971 (est)	40	17	30	0	3	90

But the prospect of other agencies picking up the discontinued programs seems fairly dim. Most agencies were victims of similar cuts; of those which received increases, neither the Agriculture Department nor the National Institutes of Health seems likely to be interested in training space scientists, and the National Science Foundation is already beleaguered by cries for funds. The Defense Department, which has an interest in space programs, is facing restrictions on its R&D funding as a result of the Mansfield amendment, limiting research to defense areas only (*Science*, 12 Dec.).

Lee A. DuBridge, the President's Science Adviser, admitted that the additional $114 million would not make up for the leveling off of R&D budgets in the past few years, nor for the effects of inflation.

DuBridge noted that government support for graduate students is declining generally. Without elaborating, he said that the government does not require as many scientists as previously.

Cuts in other NASA programs will also hurt graduate students. In the Office of Space Science and Applications, university R&D grants will be cut in bioscience by 30 percent; in the areas of physics and astronomy, the cuts will eliminate a high-energy astronomical observatory.

In the Office of Advanced Research and Technology, there will be a 30 percent reduction in university R&D, chiefly affecting research in electronics and space vehicles. And in the Office of Manned Space Flight, contracts for the Apollo program with the Massachusetts Institute of Technology will be cut by $2 million.

The grants and contracts with universities which survive the budget cuts will be oriented differently than before, Smith said. The emphasis will be not on what NASA can do for the university, but on what the university can do for NASA.

For example, the SUP summer faculty fellowship program has in the past brought faculty members to NASA centers to work on projects. Those centers which have benefited from the program will be asked to fund it in the future, and the emphasis will not be on scientific training but on contributions to NASA.

—NANCY GRUCHOW

volved. Under existing law, FWPCA could bring an enforcement action against Ship Channel polluters only at the request of the governor of Texas or if pollutants contaminating shellfish in the bay could be traced back to specific outfalls on the channel.

Last year the Texas Legislature authorized the establishment of a Gulf Coast Waste Disposal Authority, hoping thereby to overcome much of the present diffusion of responsibility for protection of the bay environment. Now being organized, the Authority will face a critical political test when it appeals to voters of the bay area for permission to levy taxes and issue bonds. If, however, it survives this test, the Authority will have a chance to carry out an ambitious program of regional water quality management comparable even to the work of the *Genossenschaften*, the regional water resources associations of the Ruhr. Under its legislative mandate, the Authority could build not only waste collection and treatment facilities but facilities of any other kind needed for cleaning up the bay, such as possibly an aeration system for the Ship Channel.

Further, the Authority is expected eventually to become self-supporting by levying effluent charges on the industries and municipalities from which it receives wastes. The Authority probably will base its charges on the quality of these wastes, thus giving its clients an economic incentive to improve their effluent quality by pretreatment or industrial process changes. Polluters do not have to join the regional system, but if effluent and water quality standards are vigorously enforced by the Water Quality Board and by the Authority itself, some polluters will have no practical alternative but to join.

Still needed is a comprehensive resource management program for the Galveston Bay system, one which could complement the activities of the Waste Disposal Authority by developing water and land-use plans to protect the bay from such things as harmful water diversions and the filling in of marshes for housing or industrial sites. The Nixon administration has asked Congress to authorize a modest program of grants-in-aid to encourage states to establish such management programs for their estuarine zones.

Even if Congress acts favorably on this possibly inadequate proposal, which is all carrot and no stick, Texas and other states will be free to decide whether to have their estuaries managed systematically or left to the kind of random and conflicting forces of use and development responsible for their present condition. However, the Texas Legislature last year ordered an inventory of the state's estuarine resources and a moratorium on the sale or leasing of submerged lands until 30 June 1973, unless the inventory is completed sooner. Also, the Galveston Bay Study and the establishment of the Waste Disposal Authority could be steps in the direction of a comprehensive program of estuarine management.

In sum, Galveston Bay is providing a classic case history of an estuary that can be rescued from its troubles only by determined and imaginative effort. Other major estuaries, such as San Francisco Bay and Chesapeake Bay, are troubled by problems of their own but none has problems more difficult and complex than those of the Galveston Bay system, especially on the Ship Channel. The problems of the Ship Channel alone are enough to put the state and federal water pollution control programs to a significant test. But while optimism is not yet in order for those who would save Galveston Bay, neither is despair. The solution to the bay's problems seems to lie in large scale research, ambitious programs of pollution control and water- and land-use management, plus tough enforcement and a close watch on the outfalls.

—LUTHER J. CARTER

West Germany: Educational Reform Is the Major Domestic Issue

Bonn. The antipollution folk movement now sweeping the United States has its counterpart in West Germany. In that country, however, it is educational reform and expansion that, after long neglect, have suddenly arrived to fill the press and meeting halls, and also to become an object of uppermost government concern. "No experiments" was the slogan that kept Konrad Adenauer in office from 1953 to 1963, and that, until the recent change of government, tended to color the thinking of his successors. But Germany today rings with public introspection over its domestic problems and with demands for experiment and innovation, particularly in the field of education, widely designated the nation's number one problem. *Der Spiegel*, Germany's *Time*-like weekly, recently devoted sections of 17 issues to descriptions and analyses of the nation's educational deficiencies, setting out a gloomy picture of overcrowding, antiquated teaching techniques and curricula, and authoritarian rule of the schools. When the first change of ruling party in 20 years brought Willy Brandt to the chancellorship of the Federal Republic last fall, he declared that "education and training, science and research are at the top of the reforms to be carried out." Later it appeared that the latter two had been found to be in reasonably good shape ("They seem to run themselves pretty nicely," is the view of a staff member at the U.S. Embassy in Bonn); this leaves education and training at the top of the top for reform. One of Brandt's first reorganization moves was to make it clear to his constitutionally decentralized country that the federal government would henceforth seek to play a major role in the educational affairs of the 11 states. This intent was indicated by appending an educational role to the fast-growing Ministry of Science, with the resulting organization christened the Ministry of Education and Science. The budgetary division between the two functions is yet to be detailed, but it has been announced that, while overall federal expenditures will be held to an 8 percent increase, funds for the new Ministry will rise by 40 percent. As is usually the case in such matters, the bookkeeping is tricky, especially since the federal role in education is starting from a small base, but there is no doubt about the priority.

As a symbol of respective national