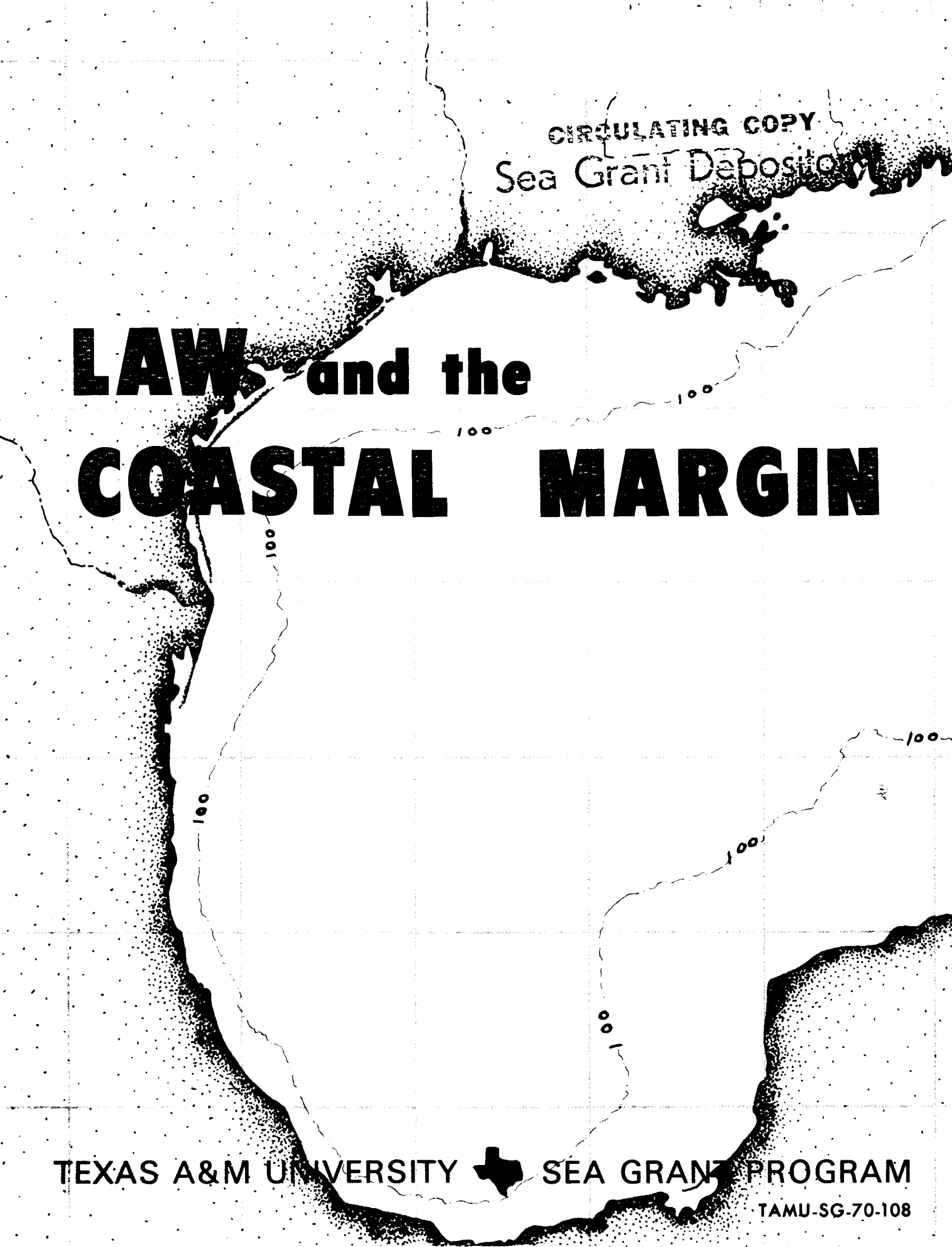
LAW and the COASTAL MARGIN



TEXAS A&M UNIVERSITY SEA GRANT PROGRAM
TAMU-SG-70-108

LAW AND THE COASTAL MARGIN

Selected Papers from the
Law and the Coastal Margin Workshop
sponsored by
Gulf Universities Research Corporation

Texas A&M University
National Science Foundation Sea Grant Program

TAMU-SG-70-108 April 1970

PREFACE

Public and private interests have long been concerned with a multitude of legal problems when considering activities in and near the coastal regions. The problems of how law and science might work together toward clarifying many of the legal problems related to the coastal margin became a topic for discussion during a two-day "Law and the Coastal Margin" workshop in October 1968.

Through an arrangement with Gulf Universities Research Corporation, sponsors of the workshop, the Texas A&M University Sea Grant Program is presenting here selected papers from the Law and the Coastal Margin Workshop. It was felt by both GURC and the Sea Grant Program that many of the topics presented at the session could serve as valuable background information for industries and agencies operating in the Texas Gulf coastal zone. Six of the ten papers presented at the workshop are given here because their contents seem to have general applicability to the Gulf coast.

The workshop was attended by 46 attorneys, scientists, engineers, and representatives from government. Central Power and Light Company hosted the meeting at Bayview, Texas.

For the first time in many instances, the specific problems relating to various coastal zone uses were identified and agreed upon by individuals representing science, engineering, and law. Recommendations for additional study and cooperative work were formulated. These are presented in the Summary chapter of this report.

The Texas A&M University Sea Grant Program acknowledges the assistance provided by the Gulf Publishing Company, Houston, Texas, in editing and evaluating the papers presented. This publication is partially supported by the National Science Foundation Sea Grant Program Institutional Award GH-59 made to Texas A&M University.

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SUMMARY

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As men turn to the sea and to the coastal margin a greater attempt to provide preventative rather than punitive laws and regulations must be made. Men of law and of science must cooperate and plan towards this end if the demands of those who use the coastal zone are to be met with efficiency and fairness.

The Law and the Coastal Margin Workshop held in October, 1968, set a precedent in the Gulf of Mexico region. Through the channels of communication which were opened and through the honest appraisal of the mutual problems of science and law came a greater understanding. From understanding will come a strengthened relationship which will benefit all those who live in and enjoy the coastal margin.

The present state of scientific knowledge can do much to assist the law in its conflicts on the coastal margin. Scientists possess the technical knowledge to assess in terms of general principles what occurs within the coastal zone. What is missing is the quantitative knowledge. For example, scientists cannot yet determine the amount of erosion or accretion or the rate of these processes from general principles. They are, however, able to say that the land will erode; but without extensive monitoring of the near-shore environment, they cannot make quantitative analyses. Data on silt loads and precise current direction and speed are needed for every location in question before a scientific appraisal can be accurately made. Accumulation of such quantitative data will serve as a vital link between science and law.

The Problems of Coastal Law

The Law and the Coastal Margin Workshop reviewed here laid the groundwork for greater cooperation between law and science in the Gulf of Mexico coastal zone. Numerous problems and their legal implications were reviewed, among them the following.

The Conflict of Ocean Uses

The priority of use of the oceans and the coastal margin is difficult to determine. Even more difficult is the question of who should be responsible for defining priorities and whether this authority should also apply to the bay and estuarine systems.

Currently, both state and federal regulations of navigable waterways exist. The Secretary of the Army and the Army Corps of Engineers' authority is based on the Rivers and Harbors Act of 1899, and is a great deal wider than the use to which it has been put. There are, in fact, few limitations to it, with the exception of controlling sewage and water run off. To date, this authority is focused primarily toward construction and dredging and there has been little attempt to bring the controls set out in the original law into active use. One reason for this restraint is that regulation does not come into being until there is a public recognition of the need for control. At the present time, the primary control related to obstructions placed in the water is achieved through the issuance of construction permits, but during the past few years the Corps of Engineers has agreed to consider the fisheries problems in its work on the coastal margin.

Another area which is receiving a great deal of attention from the Corps of Engineers is oil pollution control. When Congress revised the Oil Pollution Act and placed the authority to enforce it, after proof of willful or gross negligence, with the Department of Interior, the Corps went back to the Refuse Act of 1899. This act calls only for proof that the oil or any other refuse was placed in the water.

Another problem is industrial wastes. There are no federal regulations as to how much effluent a certain industry may dump into a river, although the Corps of Engineers has the authority to make such commitments. One reason for the reluctance of the federal government to enter into this problem is that each state is involved to a certain degree and perhaps this should be State regulated. And, the Corps of Engineers, has no policing authority to see that the regulations are carried out. Unless the demand for waste regulation is made by the public, there is little hope that the Federal government will undertake the responsibility.

An example of how one area has handled the problem of industrial waste is the action taken by the City of Corpus Christi, Texas. The citizens of this bay front town are intensely proud of the beaches and bay areas of the city and when offshore oil operators began to clutter the bay area with numerous offshore drilling platforms, the people quickly sought ways to preserve the natural beauty of Corpus Christi Bay. With the cooperation of the oil industry, the city actually passed ordinances controlling drilling in the bay, enforcing them with local polica poser. The action is similar to ones where cities control oil well drilling within the city limits. The question posed by this type of action, of course, is whether there is a basis in law that extends police power beyond health and safety to include preservation of the esthetics of an area as part of the public welfare.

The Supremacy of Navigation

Under ancient Roman law an individual had the right to pull his boat up on any banks of any navigable stream as primary servitude. To a great extent the early U.S. laws governing navigation and waterway use perpetuated the old Roman laws. These laws were passed at the time when navigation was the primary means of transporting goods. There were not conflicting uses of water.

In the *supremacy of navigation* context, the Corps of Engineers can build a structure to keep river banks from eroding and in so doing cut a landowner off from his water source without compensation. The Supreme Court has ruled for the dredging of a navigable channel in a bay or estuary and the deposit of spoil which cuts off the riparian owner from his access.

The question of whether or not navigation is, in fact, a superior use and should therefore have the right of way, is one which deserves investigation. The basic problem involved is that of determining priorities of use. Heretofore, protection of navigation has been the primary concern. With offshore activity increasing--including oil and mineral resource development--the need to protect these interests, as well as the interests of navigation becomes paramount.

A review of the origin of navigation doctrine is suggested as the first step in determining whether the laws should be modernized to take into account the other uses of coastal waters.

Licensing-Certification Needs in Navigation

Not only does navigation command an important role in use of coastal waters, but it also poses problems in certification and licensing. The rights of navigation permit anyone--even those with no navigational skills--to take any size craft into the water. No navigational instruments are required except for certain minimal safety devices as set out by the U.S. Coast Guard. With only life preservers and certain lights, anyone has the right to go anywhere on the ocean (except for government restricted areas).

The situation is analogous to the way aircraft were once flown. Today, however, aircraft cannot go into or out of many airports without certain radio and navigational gear. In the water, the problems of licensing and navigational equipment are yet to be faced. The demand is already growing to force licensing of tow boat operators. Tug operators are permitted to push barges on any waterway in the United States without any kind of license or requirements of any special skills. If the tug is handling liquid petroleum products, though, someone on board must have a tankerman's certificate. Licensing requirements or some other qualification requirements for boat operators are certainly a subject of coming concern in navigation.

The Corpus Christi case, as well as similar cases along the California coast, is a cooperative arrangement with the city and the industry involved. But in bays and estuaries along the coastline, it is possible that sooner or later the legality of police enforcement to preserve beauty and esthetics may be contested.

It is possible to establish some esthetic control through governmental agencies. A Federal agency at work in the coastal margin is the Department of Interior's Bureau of Outdoor Recreation which imposes some restrictions on areas which benefit from its program. The bureau furnishes matching funds to state agencies for the development of outdoor recreation areas. One requirement for receiving funds is that the esthetic value of the area must be preserved. In some cases, this calls for underground power lines and other measures which maintain the natural scenic beauty.

Workshop participants strongly urged State-level cooperative studies to assist in the development of priority uses for the coastal margin based on a thorough understanding of land and estuarine use. An evaluation of the need to establish regulations of land and estuarine use. An evaluation of the need to establish regulations for various uses is required. The possiblity of developing management regulations for specific activities--mineral exploitation, fisheries, navigation, recreation--must be explored from state as well as Federal viewpoints.

The Attitude of Industry

As the problems of the estuaries are brought into focus, industry should be kept informed of developments which might ultimately effect waste treatment and construction. One industry spent close to $1 million moving a partially-completed channel because of problems encountered related to the destruction of fishery grounds. When a plant is built it must compete with other industries; there is no allowance for "rebuilding". In pollution, too, science should determine a proper standard in order to reduce industrial costs. It costs a great deal of money to go into an already established plant and revise it from what was thought to have been a reasonable standard of polluting a stream to an almost non-state of pollution.

An example of the need for advance planning by industry is in the area of navigation. Twenty years ago, 200,000-ton vessels drawing 45' and 50' were unimagined. To deepen existing channels often means relocating pipelines laid down by industry years ago. Although the states issue permits for laying pipelines, they do not specify the responsibility to alter the lines in case they ever have to be changed. In the past few years, permits issued in Louisiana specify that if the channel ever has to be deepened or widened for the benefit of navigation, it will be the industry's responsibility to move the lines at its expense. Other agencies specify similar requirements.

Offshore Navigation

There are problems, too, in navigating offshore, seaward of the Gulf beaches, arising from underwater completions, mariculture, and other obstructions. The difficulty of marking underwater completions and mapping them so that fishermen may be alerted to their existence is one which becomes more pressing each day. Who should be responsible for designating these areas in deep water? Will the use of surface platforms in the vicinity of the completions solve the problem?

Advances in offshore technology should include the delimitation of areas where commercial fishermen cannot go.

Problems in Tidal Data

Coast and Geodetic Survey tidal datums often do not provide sufficient information for many areas which are becoming critical along the Gulf coast. One reason for this is that the land along the coastal margin did not become valuable, aside from the navigational standpoint, until after the boom in offshore oil, gas and sulfur. As a result, tidal datums over a range of years are available from only a few stations. Though the cost of establishing additional stations is small ($5,000 for the station and $2,000 a year to maintain it), funds to create stations have not been appropriated.

Often when tidal boundaries are established by the Coast and Geodetic Survey, the matter is still contested. Off the Louisiana coast, millions of dollars are being held in escrow while the state's offshore boundary remains unsettled. The survey techniques of the Coast and Geodetic Survey are based on the best available information, and though the margin of error is small, the property in question is too valuable to allow for error. The result is a complex lawsuit.

Real Estate Development: A Case Example

Real estate development along the coastal margin is a multi-billion-dollar business. The problems of construction, zoning, title claims, boundaries, mineral rights and myriad others face the builder-developer on coastal margin lands. There are ways, however, for the community, the state, and the individual interests to work together to bring about a successful development. The Law and the Coastal Margin Workshop discussions brought out an example of a coastal development corporation and the methods it used to solve these problems.

Padre Island Investment Corporation owns 4,000 acres of land and has developed a master plan for the development of the acreage. In early planning stages for the development, the problems of establishing property lines received great attention.

When the property was purchased, the old Boyles survey line, which was highly inaccurate, was the only line the corporation had. At the very beginning, the group decided not to contest mineral rights under the land. Preliminary discussions with the State School Land Board brought out the problems of establishing lines. The board made several suggestions which eventually led to a resurvey off the Boyles line into a new line in order to establish a new property line. Resurvey was also needed to establish a line from which a new law, called the Reagan de la Garza Act, could function in establishing a bulkhead line 100 feet out from the upland owner who was the only one, under the law, who could apply for the lease of the land in this 100 foot area.

Next the corporation did the necessary research to establish an elevation point in order to establish the 100 foot line. The State School Land Board and the corporation agreed to take the mean average of the 0.68 elevation line and strike a line which would throw half of the property into the corporation and half into State ownership, thus providing a straight property line the whole distance. The corporation could then measure 100 feet from the line and establish the bulkhead line. All of this procedure took over a year to complete.

In attempting to do these things, it is important to work within the context of the existing rules, regulations, and laws in order to accomplish solid real estate development. The Padre Island Investment Corporation's establishment of property lines was so sound that now two title companies are writing guaranteed titles.

Science, too, has a contribution to make in establishing property claims in the coastal margin. In some of the coastal environments the right kind of geological work--combined with the study of the total environment and ecological studies--can firmly and accurately reconstruct the history of the land growth from all sources. In the Luttes case, geologists were able to identify the part of a mudflat that grew by accretion to the mainland and the part that grew by accretion through the island. The joining line of these two processes was established, thereby settling the matter of apportionment. at least from the scientific point of view. This can be done accurately in most of the island harbors, although it only applies to bays and lagoons and not to the seaward side of barrier islands. In these kinds of problems, scientific services can assist the law in making sound decisions.

Another area which will require the cooperative talents of science and law is in the realm of beach protection. In the present state of Texas law, the landowner is running a substantial risk if he establishes groins to protect the beach from erosion. In some cases there have been disastrous effects and some losses on the basis of depriving the injured owner from his fair share of the accretion process. Here coastal engineers and lawmakers must work together to set up fair and equitable standards.

Man's Use/Misuse of the Gulf

In the development of laws and regulations, little consideration was given to the population growth, the projections of which are now overwhelming. When original regulations were set up, the problems of overcrowding along the coastal margin were unknown. With increased numbers has come increased liability. In some Gulf coast areas, it has become economically infeasible to construct navigational channels that cut across important fisheries and nursery grounds. The cost of altering previously laid pipelines and bridges is prohibitive.

Still, the near shore and offshore construction takes its toll in the ecological balance of the marine environment. To abate the marching destruction set in motion by improper planning, federal and state agencies are studying the coastal areas to determine what effect water resource development in river basins has had on the coast. What is required to maintain the *status quo* of these areas and what it would take to restore them are other questions which must be faced. There are also problems from the standpoint of liability that the present laws cannot reach and cannot handle. The estuaries are the nursery grounds for a large percentage of the food and game fish that are caught on the continental shelf. No one has proprietary right to these fish so there is no one to act as plaintiff to seek damages for the killing of the fish in the nursery stage. Workshop members felt the need for greater control over important estuarine areas.

Public Law 90-454, passed in August, 1968, provides a means for considering the needs to protect, conserve, and restore the estuarine areas of the United States. Under the law, the Secretary of the Interior is required to work with the states and other federal agencies in conducting a study and inventory of the nation's estuaries. The term estuaries is broadly used to mean the coastal margin, bays, sounds, seaward areas, lagoons, and lands and waters of the Great Lakes, without limitation.

The inventory will include, among others:

1. Wildlife and recreational potential; ecology; value to marine anadromous and shell fisheries; and esthetic value.

2. Importance to navigation; flood, hurricane, and erosion control value; mineral value; value of the submerged lands beneath the waters of the estuaries.

3. Value of the areas for more intensive development for economic uses insofar as urban development, commercial, and industrial development is concerned.

The broad concept of this Federal law leaves room for a number of possible approaches to the competing use of our coastline. The act is

a first step and when the findings are reported to the Congress in 1970, the question of how to preserve the resources of the coastal zone will be squarely faced as well as the decision of whether controls should be set at the Federal or State level.

State and Regional Cooperation

It has been said that the individual states have done little in the conservation and management of the living resources of the coastal margin, either because of lack of cooperation or competition among the states. In fishing regulations, for example, some states have restrictive legislation applied against the citizens of other states. One approach to the problem is through interstate compact systems such as the Gulf States Marine Fisheries Commission. Fish do not observe political boundary lines. Where there is special legislation for one county or state, it doesn't do any good if the next county or state has another type of regulation.

Although each state probably should have its own fisheries code, interstate commissions have been able to eliminate friction between states.

Florida, for example, has a territorial sea of three marine leagues. Alabama, right next door, has a territorial sea of one marine league. The Attorney General of Texas has pointed out that Texas and Louisiana are going to be faced with the same situation--that of determining where the lateral boundary is. This means that off the lateral boundary of Texas and off the lateral boundary of Florida, there is a quadrant--a right angle area--that is designated high seas. On one side is Florida territorial seas, and on the other side is Alabama territorial waters. Alabama and Florida already have an agreement which says that the lateral boundary between them starts from a designated point and extends seaward to the limits of state jurisdiction. The two states also have a reciprocal agreement on shrimp.

There is really only one basis for fishery regulation and that is the concept of sustained yield. There are, however, a number of restrictions that are valuable. Net restrictions, for instance, which set out to save a portion of the stock for nursery grounds, are certainly needed. The mechanisms for the regulation of coastal migratory fishes, though seem to transcend state regulations and would best be regulated by marine organizations such as the Gulf States Marine Fisheries Commission.

The U.S. has an interesting fisheries arrangement. We have a three-mile territorial sea and we have nine miles beyond that which is reserved exclusively for U.S. fishermen. On the outer nine miles, there is no clearcut law for regulating the fishing catch. Beyond that limit, we go into international law and international agreement.

Another problem facing coastal states deals with sport fisheries. Commercial fisheries exceed it only in terms of pounds landed. The number of people involved in sport fishing and the amount of money they spend each year are much greater than that of commercial fisheries. In California and some other States, where there is conflict between the sport and commercial fishermen, where the resource is really in danger, where the combined forces are already taking more than the reserve stock can stand, the state has said that the fishery will be reserved for that group whose use of the fishery will provide the greatest good for the most people--in other words, the sportsman.

Science and Law

After examining coastal law in Louisiana, one participant at the workshop pointed out that as high as 70 per cent of the laws in that State have no basis in scientific fact. These are old laws having to do with social and economic problems in the commercial fishery resource level. In sports and recreational fishery areas, the local groups do not want outsiders catching their fish and taking their oysters. Science, on the other hand, approaches the same problems from the maximum yield viewpoint rather than a sociological viewpoint. This scientific information is available to lawmakers for their use in streamlining laws and making them easier to enforce. In order to do this, there must be interaction between science and local interest groups. It is an educational problem which might be approached through dual science-law cooperation.

Education, too, must be carried out within the science-law complex. There must be some "house cleaning" that will clear the air between trial lawyers and testifying scientists. The workshop members felt that one mechanism for bringing about greater understanding between science and law is working sessions, in the form of workshops, symposia, or seminars, which bring the two groups face-to-face with their mutual problems.

Specific Recommendations

Members of the workshop panels also identified twenty specific areas for additional study which were felt would bring about greater understanding and cooperation:

Study of the origins of the doctrine that navigation is the superior use of the water.

Future requirements for minimum navigation instruments and navigation skills for boat operation in coastal waters, including identification of water areas requiring precise navigation routes.

Need for future certification or licensing of boat operators in regard to various operational skills including navigation.

Evaluation of need to establish regulations for priority of use of water areas for various purposes other than navigation; recommendations concerning which governmental bodies and agencies should have the responsibility and authority for water use management.

Need for regulations or ordinances for control and enforcement of preservation of the esthetic values of coastal areas and waters.

Need for uniform study of present land and water use of the coastal margin of the Gulf of Mexico.

Need for oceanographic data related to coastal processes as a basis for planning navigation and other engineering projects designed to involve minimal coastal modification and associated legal problems.

Need for evaluation of:

(a) Effect of river basin engineering projects (water conservation, navigation, etc.) on management of coastal margin land and water use;

(b) Feasibility of coordinated legislation of river basin-estuary-coastal margin projects.

Need for state of knowledge survey of existing jetties and groins and their effect on riparian changes (erosion and accretion) of the coastline.

Evaluation, establishment, and operation of a network of tidal gauges located specifically for the purposes of determination of mean high water elevations for bays, estuaries, and Gulf shore lines, acceptable for legal purposes.

Need for an inventory of laws and regulations effecting the coastal margin, including review of existing inventories.

Need for inventory of living and natural resources of the coastal margin as background for evaluation of activities on the coastal margin having unique legal requirements.

Need to extend to all Gulf States the current effort of Louisiana, Mississippi, and Alabama in cataloging and analysis of laws pertaining to the marine environment.

Need for critical summary of significance of river basin studies, currently in progress by the Corps of Engineers, to coastal marine environment.

Need for evaluation of the boundaries of public beaches including the legal aspects of public access, protection of rights of adjoining private property owners, and enforcement of laws related to public use of the beaches.

Need for evaluation of the scope, magnitude, and problems of marine recreation.

Need for evaluation of legislation required to regulate the modification and use of private and public property for aquaculture.

Need to develop a methodology for monitoring the fresh water-salt water boundary and evaluate the significance of the boundary in regard to public and private ownership of land and water.

Need to evaluate both the cause and legal implications of salt water intrusion into fresh water supplies, both surface and subsurface.

Need to evaluate and integrate the social and legal aspects of studies of littoral drift of sediments.

THE COASTAL MARGIN: ITS NATURE AND USES

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> "Roll on, thou deep and dark blue ocean - roll! Ten thousand fleets sweep over them in vain; Man marks the earth with ruin - his control stops with the shore."
>
> Childe Harold, Lord Byron

Man's distribution and, to a degree, his migration have been determined by the position of the most definitive and dynamic geographic boundary of our planet--the line along which the land meets the sea. In earliest times, the sea beyond the westernmost shores of the Mediterranean was the great abyss of man's ignorance. Today the sea floor is the latest frontier for man's future economic growth. As human population has burgeoned, the coastal margin has become a zone of ever-increasing activity for settlement, recreation, industrial development, resources exploration and production, and, alas, for the mass dumping of man's wastes. In the coastal margin and beyond, advances in technology are leading man to greater involvement with the sea, not just for travel across its surface but also for extracting raw materials from its waters and from the sediment and rocks beneath. Consequently, our coastal land in the decades ahead will become densely populated; our continental shelves will be explored extensively for resources.

Definitions

Before the nature of the coastal margin is specifically discussed, a few basic definitions should be established.

Coastline is the line marking the seaward limit of land permanently exposed.[1]

Shore is the zone over which the waterline, the contact between land and sea, migrates during diurnal tidal cycles and during storms. It is the margin of land washed by the sea.

Coastal margin is the area of land and sea bordering the coastline. As used in this discussion, it includes that part of the land which is affected by its proximity to the sea. Landward the limit is necessarily arbitrary but extends inland several miles to include metropolitan areas that are built on and around major estuaries that open to the sea and on flat coastal plains once covered by the sea. Seaward the boundary is the edge of the Continental Shelf or the approximate 200-meter depth isobar.

Coastal plain is the level plain composed of horizontal or gently sloping strata fronting the coastline and generally representing a strip of recently-emerged sea bottom.

Continental Shelf is the zone bordering a continent and extending from the line of permanent immersion or low-water level to a general depth of 200 meters where there is a marked descent toward the greater depths.

Mobility of the Coastline

Geologic processes have outlined the geographic pattern of Earth's surface and the position of the coastline at any given time in Earth's history. The nature of the coastline has determined man's use of it.

Reconstruction of previous coastal margins is an important task of the economic geologist. Deposits of oil and gas seem to have formed along older coastal margins. Criteria for recognizing older coastal margins are critical to appraising the mineral potential of older sedimentary rocks now exposed on land.

Long-term fluctuations

To the infrequent visitor, the position of the coastline seems eternal. To those more familiar with the coastline, changes that are relatively minor, but nevertheless of a permanent nature, are apparent during the span of a lifetime and sometimes over shorter periods. In the perspective of geologic time, however, the entire face of Earth has been remolded many times. The contest of sea against land has raged in slow motion across the globe for at least three billion years; each strives to encroach upon the other in the eternal battle for supremacy.

The magnitude of coastline migration during geologic time has been extensive. During the Pleistocene Epoch, the Continental Shelves were exposed as land and our predecessors probably lived there. The sea level has risen 300 feet in the past 20,000 years as a result of the melting of continental glaciers. If glacial ice continues to melt until it is depleted, the sea level will rise an additional 250 feet. This figure is an estimation and projection based on curves drawn for the highest stands of sea level during the Ice Age.[2]

The effect this rise in sea level could have on human settlement is readily apparent if one notes the position of the major metropolitan areas. Some sixteen metropolitan areas having a combined population in 1960 of 28.5 million would be wholly or partly inundated. Even if no population increase is considered, there would be 28.5 million persons plus another 30 million or so within the inundated area who would have to migrate to higher ground. The upper parts of dominant structures such as the Empire State Building, Washington Monument, and the Statue of Liberty will protrude out of the sea as archeological fingers marking sites of man's past habitation.

Our problems of the land, the sea, and the law are of a much more immediate nature. The position of the coastline some tens of thousands of years in the future need not concern us here. Nevertheless, consideration of the coastal margin in all its aspects leads us to a few moments of contemplation of man's future dilemma if he is forced to fit more people into less land area.

Short-term fluctuations

Short-term changes affecting the coastal margin and man's use of it are of two main types: those of a periodic or regularly recurring nature such as the tides and seasonal currents and those of an irregular or catastrophic nature such as hurricanes, tsunamis, and floods. The effect of major hurricanes upon human settlement along the coastline hardly needs reiteration. During the history of our country, hurricanes and major storms have caused changes in the coastline as well as property and erosional damage to coastal areas resulting in losses estimated at more than $1 billion. A single major storm not of hurricane proportions that moved along the northeast coast from Cape Hatteras to Maine in March, 1962, caused damage estimated at $190 million.[3] Figures for the number of lives lost in the United States during hurricanes over the past 150 or so years are not available, but it would be safe to estimate the total at more than 12,000 by projection from statistics available to 1888 (World Almanac).

Tsunamis or tidal waves have not been frequent along our coastline, only infrequently affecting the West Coast of the United States. However, as a catastrophic event, their effect has on many occasions been devastating in other parts of the world. Unfortunately,they cannot be

predicted, either in time or magnitude. Unlike hurricanes which can be tracked, tsunamis travel about 400 miles per hour and there is little time for an alert. The great tsunami in the Pacific triggered by the eruption of Krakatoa in 1883 caused a tidal wave that drowned more than 36,000 persons in the East Indies and did damage on the western coast of South America 3,500 miles distant.

Classification of the Coastline

The length of the coastline of the United States, including bays and sounds, is roughly 68,000 miles. (The actual length may be several thousand miles more because the measurement on a map at a scale of one inch to 45 miles did not include myriad coastal indentations.) The figure given is not intended for finite accuracy but is included to show the extent of our sea frontage. Beyond the coastline on the submerged Continental Shelves are 950,000 square statute miles of sea floor--from the standpoint of national interest, our front yard--to place the size of the shelf in perspective, it is an area one-fourth as large as the continental United States.

Our coastline is by no means uniform, a fact that is obvious to those who have visited the seashore in various parts of the country. Indeed, the diversity of our coastline has determined to a large degree its use for human settlement and commerce in the past. The degree of this diversity and its relation to regional meteorological patterns should guide our planning if we are to use the coastal margin and its resources wisely.

In the following sections the topographic differences of the coastline are discussed. The classification used is a combination of a descriptive and modified geomorphic classification that considers neither origin from the standpoint of depositional processes nor by geologic evolution. Some of the descriptions are modified from McGill, 1960.[4]

Hilly Coastline of Moderate Relief

The northeast coastline from Maine to the Hudson River, i.e., the New England coast, has been cut into a geologically-complex upland surface of moderate relief underlaid by metamorphic, igneous and older, highly indurated rocks. Also characteristic of this coastline are deposits of rock debris left behind by continental glaciers. This coastline is destructible as erosion takes place all along it at varying degrees. The coastline in general is rocky, yielding grudgingly to wave action. Exceptions are found where cliffs are being cut from the thick deposits of rock debris. Sea cliffs of varying heights, cobble beaches, and discontinuous, narrow sandy beaches (excepting Cape Cod), are characteristic as are deep embayments between headlands, numerous small embayments, and large diurnal range between high and low tides.

Short-term changes in the hilly coastline are relatively minor. Cliffs remain generally stable when viewed in the perspective of decades, except for those being cut into incoherent glacial debris. Beaches, on the other hand, retreat and rebuild from year-to-year and even from season-to-season. However, coincidental timing of the normal high diurnal tides with flood tides attending hurricanes and other major storms can bring about devastatingly high tides that cause extensive damage to harbors and to settlements on low land. Man-made modifications, too, are not extensive--dredging and channeling are minor because of deep natural harbors.

Sandy and Marshy Plains

The coast from Long Island to the southern tip of Texas is characterized by level to gently sloping coastal plains underlaid by flat, poorly consolidated sedimentary rocks of geologically recent origin. A number of coastal features are typical: wide sandy beaches of great extent parallel to the coastline; barrier islands, commonly called outer bars, separated from the inshore coastline by lagoons and bays; locally extensive marshes, such as the Everglades; sand dunes; and a smooth, gently sloping sea bottom and extensive Continental Shelves whose width is measured in tens of miles.

This coastline is on a plain. It intersects a surface of little relief. Low sea cliffs are locally developed in soft material, but they are not characteristic. It is in most places a constructional coastline of shifting sands and desolate marshes--parts of which are at once a boatman's nightmare and a hunter's delight.

Natural changes brought about by storms are common to the sandy plain coastline. These range from temporary flooding of extensive coastal areas to the erosion of beaches and barrier islands. A single storm can cut new inlets, remove parts of islands and old shoals, and create new ones.

From Long Island to Cape Lookout, North Carolina, the coastline includes extensive but shallow embayments (the largest being Chesapeake Bay and Pamlico Sound) and long stretches of dune-marked barrier islands (the best known are the "Outer Banks" of North Carolina). It is pertinent to mention at this point that this stretch of coastline was once noted for its yield of shellfish. The word *once* is significant here, and it shall be referred to again in discussing uses of the sandy plains.

From Cape Lookout to the central Florida coast, the barrier islands are generally less continuous to non-existent, while coastal marshes are numerous and continuous for long stretches. The rivers from this sector, particularly those in South Carolina and Georgia, contribute much sediment that is carried southward by longshore currents as far

south as Florida. As a matter of fact, sediment reflux and sand movement by longshore currents are very active along the entire Atlantic segment of the sandy plain and marsh coastline.

The Florida coastline is variable: from Florida central to Miami, long, narrow stretches of the coastline consist of continuous narrow barrier islands separated from the mainland by very narrow lagoons. From the southern tip and west coast to the panhandle area of Florida, conditions range from marshes to discontinuous barrier islands and contain several prominent embayments. The Florida panhandle coastline extending into the coastal areas of Alabama and Mississippi is mainly a combination of barrier islands and bays that includes the Apalachicola River delta.

The Louisiana coastline is dominated by the extensive Mississippi River delta--a large area of marsh and river floodplain. The delta is the result of sediment outpouring into the Gulf of Mexico at a tremendous rate during the past 5,000 years. Sediments discharged by the Mississippi River are deposited all along the northern coastal margin of the Gulf of Mexico.

The Texas part of the sandy plain coastline is marked by prominent shallow embayments and extensive barrier islands. Padre Island, continuous along the south Texas coast for more than 100 miles, is the longest barrier island in North America, if not in the world.

The combination of low relief and geographic position within the hurricane latitudes of the southern Atlantic Ocean and the Gulf of Mexico means almost yearly flooding of parts of the sandy plains coastlines of the United States. This situation has influenced coastline use in the past. However, the press of coastal settlement in recent years seems to be proceeding without proper tailoring of coastline use to the natural setting.

Mountainous Coastline

The Pacific Ocean meets the western boundary of the United States along a coastline that is typically hilly to mountainous. The mountain ranges along the Pacific coast are referred to as the *coast ranges*. The coastline of California varies from sandy beaches in the south to steep cliffs and fog-hidden hills in the north. Two prominent embayments mark the California coast: San Francisco Bay and Monterey Bay. The coasts of Oregon and Washington are also hilly to mountainous. Several prominent rivers traverse the coastal ranges of Oregon, and their drowned mouths form embayments along the coast. Large embayments such as Willapa Bay are more typical of the Washington coast. Puget Sound, of course, dominates the coastal margin of northwest Washington.

The most mountainous North American coast is along the coast of Alaska, particularly the south and west coasts. Mountains partly

drowned by the sea give Alaska two other characteristics: myriad embayments and coastal islands that in aggregate give Alaska a 34,000-mile coastline. The Arctic Coast of Alaska, until recently a seldom-mentioned piece of United States real estate, is a coastal tundra that is the object of intensified interest as a result of the recent discovery of what is now confirmed as great quantities of petroleum. Lease sales in August, 1969 totaled a staggering $900 million in bonuses.

The mountainous coastline of the western United States is one of extensive sea cliffs cut into rocks that are indurated but less durable for the most part than those of the hilly New England coast. Consequently, the combination of high wave energy acting against only moderately resistant rocks leads to numerous large landslides along parts of the coast.

Beaches along the Pacific Coast typically lie in narrow strips at the base of high sea cliffs, although the beaches of Southern California are extensive.

The Continental Shelf

The submerged Continental Shelves along the Atlantic seaboard and Gulf of Mexico are typically wide, ranging from 15 miles near the southern tip of Florida to almost 200 miles off Massachusetts (the average width being about 70 miles) and about 2 to 180 miles wide along the northern coast of the Gulf. The sea floor on the shelves of the western Atlantic and northern Gulf coasts is nearly flat and contains no prominent topographic features. The shelves are underlaid by a great wedge of sedimentary material that eroded from North America and spread a vast apron around the continent. The thickness of this wedge of sedimentary rocks may be as much as 50,000 feet or more in the northern Gulf of Mexico. Conversely, the shelf along the western United States is generally narrow, less than 30 miles wide and resembles a step cut into the continent.

Uses of the Shoreline

From the foregoing, necessarily brief, description one can see that *diverse* properly characterizes the nature of our shorelines. In the previous periods of national growth and development, the nature of the shoreline largely dictated its use. Thus, the natural deep harbors of the Northeast and West Coasts gave rise to shipping as a major enterprise resulting in rapid settlement in those areas.

Increased activity and settlement along the coastline have resulted in the modifications that man deemed necessary to make use of the sea more convenient. Man's use and subsequent modifications of the coastline fall into four major categories:

1. harbors for shipping

2. industrial development

3. settlement

4. recreation.

Shipping

The need for shipping outlets along the sandy plains coastline has meant cutting artificial passes through estuaries, bays, lagoons, and barrier islands. Twenty-five artificial or man-made harbors have been created in Texas alone.

Industrial Development

Industrial development has been heavy along many segments of the coastal margin, particularly in the northeast, middle Gulf Coast, and parts of California. Much of the industrial growth has been around bays and estuaries where harbors can be easily built.

On the Continental Shelf, the extraction of mineral resources from substrata is already underway on a large scale. More than 8,000 oil and gas wells have been drilled on the shelf of Louisiana and Texas. Exploration and production of mineral resources of all types will increase. Though production has been greatest in the Gulf, Georges Banks in the Atlantic and the shelves of the Bering Sea and Arctic Ocean show great promise.

Settlement

Settlement along the coastline has increased tremendously over the past 30 years--both for year-round living and summer shore communities. The increase has been greatest along the northeast coast adjacent to *megalopolis*, along the east and west-central coasts of Florida, and along much of the California Coast. Settlement along these coasts is expected to increase at an even greater rate. It is estimated that by the year 2,000 A.D. there will be two persons for every foot of United States coastline.

Settlement has meant extensive dredging for housing-development marinas, draining of coastal swamps, leveling dunes, cutting numerous artificial passes for boats, and creating fill-land. The creation of new land for housing developments peripheral to San Francisco by dredging mud from the bay floor is the most notable example of such activity in the United States.

Recreation

The demand for outdoor recreation has increased in the post-war period at five times the rate of increase of population and income.

The major pressure for outdoor recreation, especially in the heavily-populated areas of the northeast, takes place along the coastline--for camping, boating, fishing, and just plain romping on the beach. Anyone who has attempted to enjoy the beach along north Padre Island this past summer (1968) can appreciate the mass migration to the beaches on weekends.

Implications of Man's Use of the Shoreline

The history of our nation's growth has been based in large measure on the individual's freedom of action. Individuals and groups have had freedom to attack the frontier, freedom to plan and develop, and most of all the freedom to use the natural resources of our land almost at will.

Development along our coastline has proceeded with few restraints. Man has located on and used the coastline in direct proportion to his ability to buy and develop property. Inland much of man's activity within his own domain affects only those persons on either adjacent property or nearby. (We will not get into the matter of air pollution here.) However, along the coastline an activity or situation at one locality can affect many persons along the coastline. Longshore currents are prominent along all segments of our coastline. These currents, the coastal winds, and the sediments entering the coastal margin counteract to maintain an energy balance.

Man's activity in recent years has upset the natural balance along some segments of our coastline. The natural habitats of the biota along the coastline are controlled by depth of water and physical, chemical, and energy characteristics of the water in the sea, in the bays, and in the estuaries. This balance is important because the waters of the coastal margin yield most of the seafood taken from the ocean.

The cutting of channels and dredging often has been done without knowledge of current patterns and sediment distribution and has resulted in erosion of barrier islands to the detriment of navigation and property. Dumping of industrial wastes, including thermal waters, into some of our estuaries either exterminated or contaminated the shellfish. Oysters along the New Jersey coast now contain toxic quantities of zinc.

Perhaps the most undisciplined use of the coastline has been in the matter of settlement. The sandy plains which lie in the hurricane belt offer little resistance to storm action. Not only is settlement taking place in low areas susceptible to flooding but in many places dunes, the only natural barriers to flood tides, also are being flattened in the settlement process.

Increased use of the coastline can be predicted as surely as can the population explosion. Increased engineering along the coastline and exploration for minerals on the Continental Shelves will bring a need for more accurate large-scale maps. Man's modification and settlement along the coastal strip necessitates revising coastal topographic maps every few years.

Land-use classification of the coastline must be considered: should we restrict segments of low-lying coastline that are susceptible to high storm damage to recreational use? Shall we allow pollution of our inshore waters that ruin, both commercial and sport fishing? How are we to handle great masses of sea floor sediments during mining on the continental shelf? How are we to deal with open-cut mining along the coastline where disturbance of the freshwater table may cause saltwater encroachment and ruin potable water? Shall we continue to build homes on fill-land in areas of high earthquake hazard? Who will be responsible--the developers or the home owners?

These and many more questions must be answered in the next few years if we are to use our coastline wisely and if it is to be developed in the manner that is most beneficial to all.

Concerning the role of the law in planning for coastline use, two general needs seem pertinent: 1. Additional restrictive covenants should be based on sound scientific principles to guarantee the efficient use of the coastline which require both the awareness and the will of the legal profession; 2. The legal and scientific professions should not wait for the human crisis on the coastline; they should lead in anticipating it.

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MAPPING THE COASTAL MARGIN

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The Coast and Geodetic Survey, chartered by Congress in 1807 to survey the coast and harbors of the United States and the outlying islands and fishing banks, began making hydrographic surveys in 1834 and published their first nautical chart in 1839.

Basic coastal topographic and hydrographic (Figures 1 and 2) surveys for producing nautical charts (Figure 3) required a network of accurate positions and elevations necessitating astronomic and geodetic surveys. The knowledge of tides needed to reduce water depths to a common datum initiated the establishment of tide gauges along the coast. As sea commerce expanded, tidal current studies and the determination of changes in the Earth's magnetic field were necessary to promote safe navigation in coastal waters. In recent years, the scope of the bureau's activities has expanded to include seismological investigations and the preparation of aeronautical charts for civil and military use.

As recently as fifty years ago, the boundary of the seashore was of little interest. The coast was sparsely settled and land values were comparatively low. Today with the expanding economic and offshore mineral development there is an increasing need for accurate boundary determinations. The existence of low-lying sand beaches, mud flats, and marshes add to the complexities of determining this boundary.

Mean High- and Low-Water Line

The base lines from which inshore and offshore coastal boundaries are located vary from state to state. Generally, the determining line is the mean high- or low-water line in the Atlantic or Gulf States and the mean higher high- and lower low-water lines on the Pacific coast. Surveying of these lines is the subject of this Chapter with the discussion first turning to the historical records available to

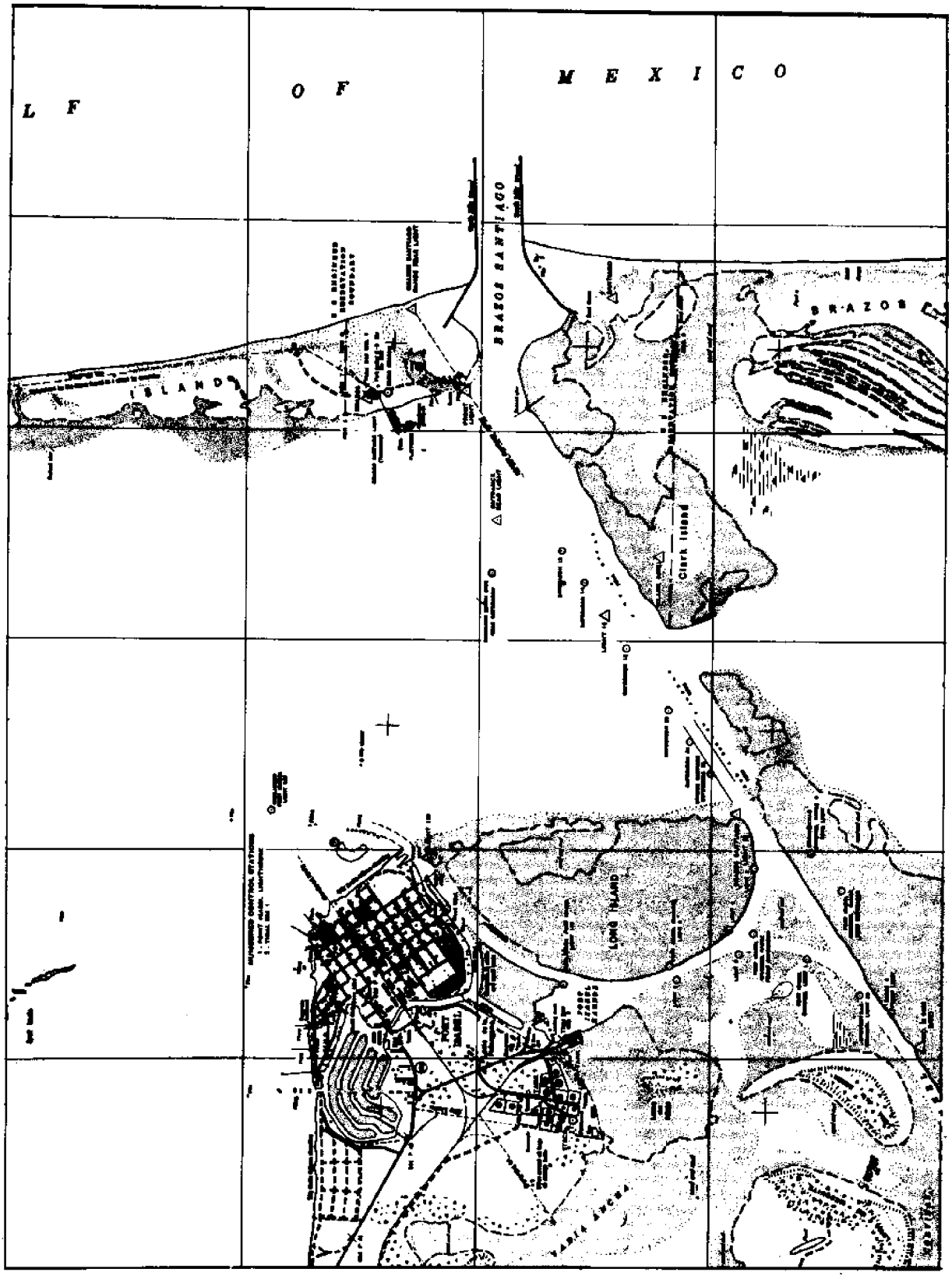

Figure 1. Topographic survey of the Gulf of Mexico region

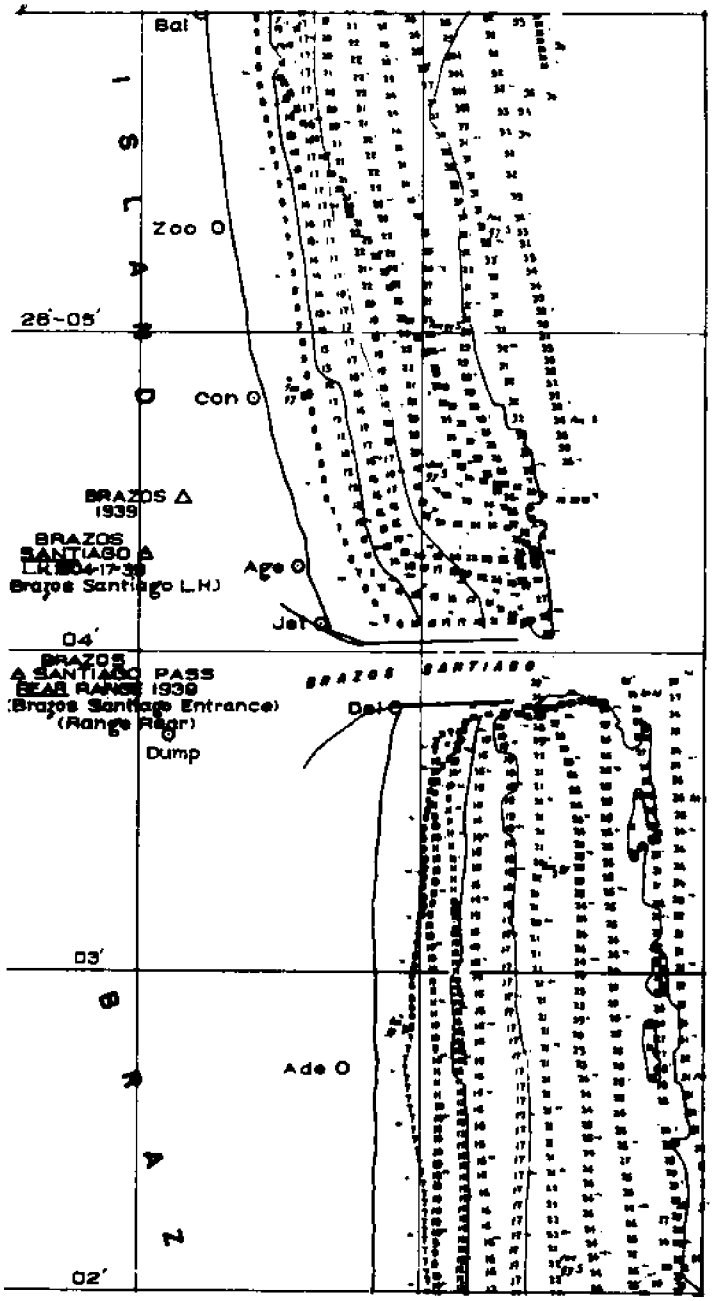

Figure 2. Hydrographic survey of an area in the Gulf of Mexico

determine these lines at various times in the past and then describing the establishment of tidal datums and techniques used to map the required baseline.

Coast and Geodetic Survey Archives

The archives of the Coast and Geodetic Survey, in addition to the published nautical charts (Figure 3), contain a vast store of records and large-scale survey sheets. This information has been quite valuable in laying out shore and sea boundaries. We must recognize, however, that the charts, and the surveys from which they were compiled, were made for safety in navigation and not for boundary purposes.

In mapping the shoreline on nautical charts (Figure 4), the general practice of the planetable topographer or the field inspector of aerial photographs has been to identify the mean high-water line by examining the watermarks and other features of the shoreline rather than by leveling from tidal bench marks. The low-water line of off-lying islands and low tide elevations are mapped partly by the topographic survey of the shore and partly by the hydrographic survey. The work division is a matter of expediency and varies with the area. The approximate low-water line is mapped by the topographic survey if the aerial photography was taken at approximate low water or if the planetable topographer can conveniently work in the area of the shore when the water is at or near low tide.

Tide-controlled photography, to be described later, is being used extensively for shoreline mapping. The topographic field inspector ordinarily judges whether the elevations of the tops of detached rocks lying close to shore are between mean low-water and mean high-water or above mean high-water by observing and using the predicted tide tables.

Much of the low-water line on nautical charts is mapped by the hydrographer. He sounds over this line at higher stages of the tide and then reduces these soundings in accordance with the tide records (Figure 4). The mean low-water contour is then drawn through the zero soundings. The hydrographer also positions and determines the elevations of many of the off-lying low-tide elevations. He knows the approximate stage of the tide from the predicted tide tables and can usually estimate the elevation of the top of a feature and note this fact in his sounding record. He usually records the approximate elevation of rocks or shell banks lying far enough offshore to be of importance to navigation. In this last situation, he estimates the height above water (often in a running sea). This height is then reduced to an elevation about the sounding datum by reference to the tide records.

Coast and Geodetic Survey practice in charting rocks awash or shell banks (low-tide elevations) on the Atlantic and Gulf coasts is to show a rock awash or low-water symbol on the nautical chart for land features that are bare anywhere between one foot below mean low-water to one foot above mean high-water (on the Pacific coast these limits are two feet

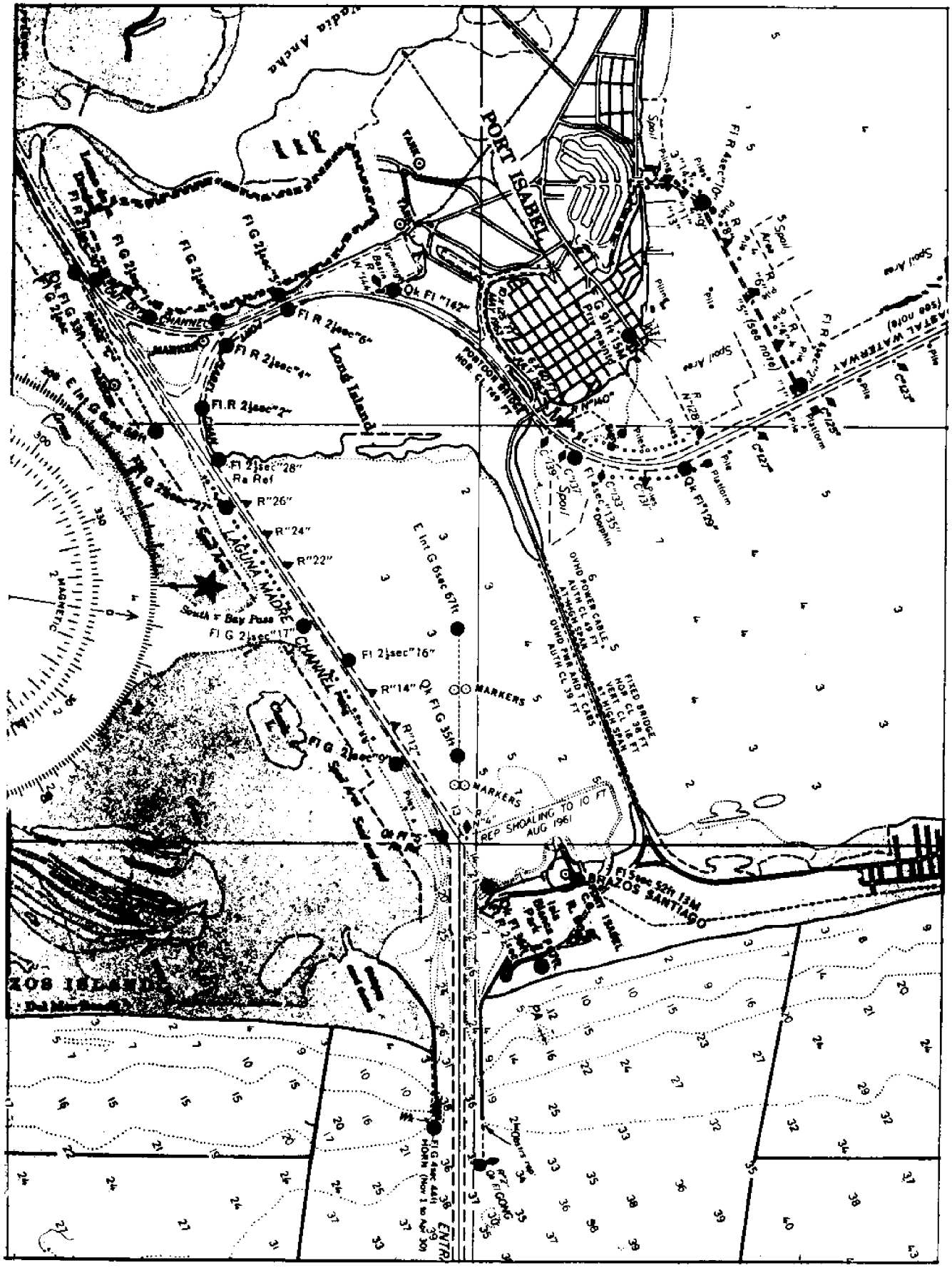

Figure 3. Typical nautical chart of the Gulf of Mexico

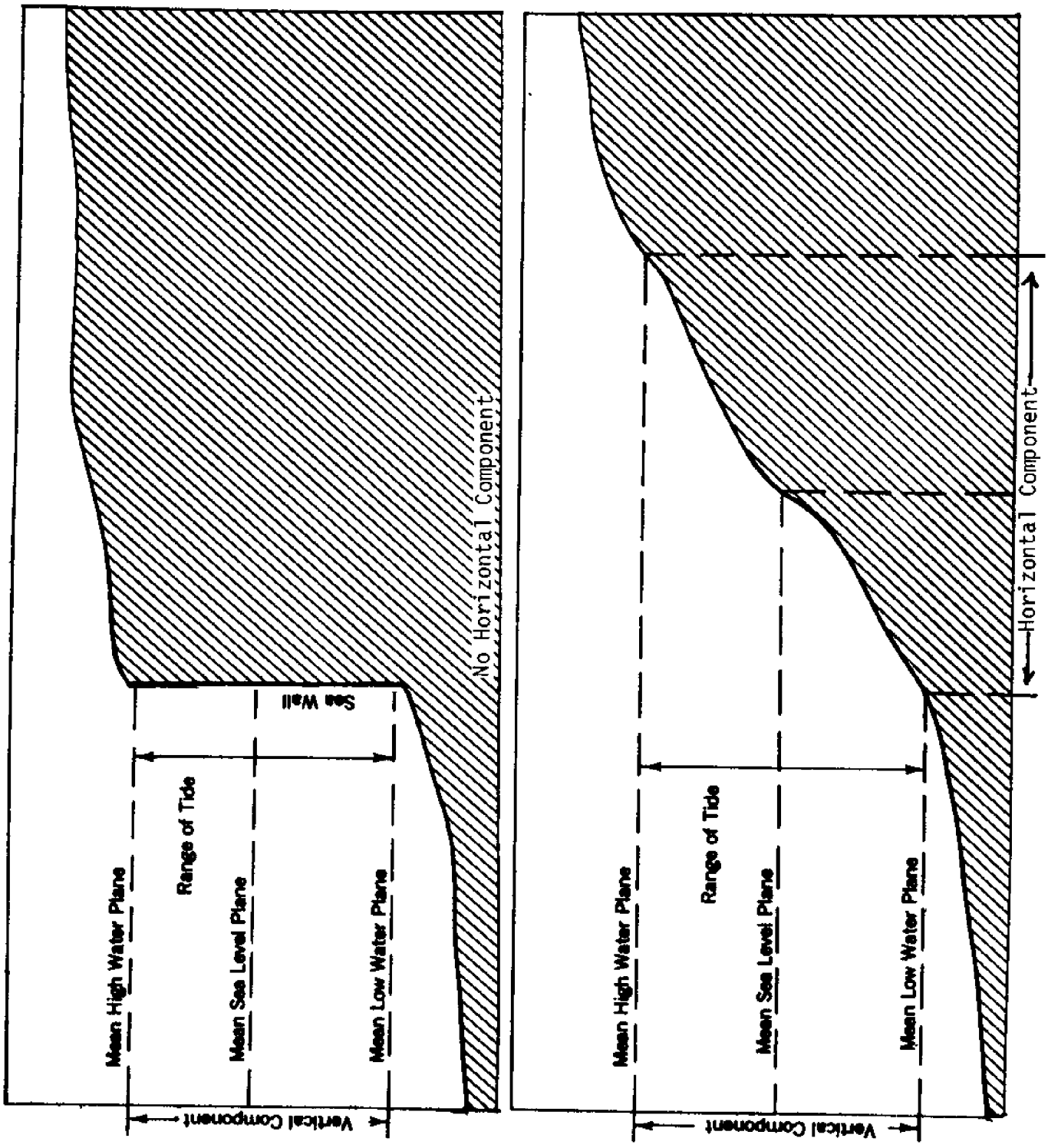

Figure 4. Example of shoreline profiling

below mean lower low-water to two feet above mean high-water). This is done as a precaution for navigation without relation to boundary matters. On the other hand, a low-tide elevation is a land feature that is bare at any stage of the tide between the low-water datum and mean high-water. Thus, the question will arise occasionally as to whether a rock awash shown on a chart may possibly be covered at low water or may be just bare at high water, making it in island. These questions can often, but not always, be answered by reference to the survey records.

Tidal Boundaries

The mean high-water line is defined as the line of contact or intersection of the tidal plane of mean high-water with the shore. Similarly, the mean low-water line is the intersection of the tidal plane of mean low-water with the shore. These definitions show that the survey of a tidal boundary involves two components: a vertical component, the elevation of the tidal plane referenced to recoverable marks on the ground; and a horizontal component, the position on a contour map representing the intersection of the desired tidal plane with the sloping shore.

The determination of the vertical component, the tidal datum, would be relatively simple if, at any place, the tide rose and fell to the same elevation everyday. There are, however, considerable variations in tidal heights everywhere, caused by astronomic forces, bottom topography of ocean basins, configuration of bays and estuaries, and meteorological phenomena. These factors are complex, and three of the four are variable within themselves. Consequently, there are an almost unlimited number of combinations into which these four factors can unite to produce variations in the range of the tide at the same time at different points and variations at a point at different times.

The Astronomic Tide-Producing Forces

The movement of the ocean waters that causes the vertical rise and fall of the tide is in turn caused by the combined gravitational forces of the moon and the sun, with the moon exerting the greater force. The principal characteristics of the tide resulting from these forces are:

1. During each period of slightly more than 24 hours, we have (in most places) two high and two low waters. This rule, however, is not invariable either as to time or place.

2. The high and low waters of each day occur about 50 minutes later than the corresponding ones of the preceding day. This lag corresponds and is related to the daily retardation in the time of the moon's meridian passage.

3. The range of the tide (the vertical difference between low water and the preceding or following high water) at any point changes from day to day, passing through a fortnightly cycle. When the moon is in its first and third quarters, the tide-producing forces of sun and moon are opposed and, other factors being equal, the tidal range attains the minimum of its cycle. This minimum is called the *neap tide*. Thereafter, there is a gradual increase in range until the time of new or full moon. At that time the tide-producing forces of the moon and sun are in conjunction and, again other factors being equal, the tidal range attains its maximum for the cycle and is known as the *spring range* or *spring tide*.

4. The moon travels around Earth during a lunar month of 27 1/2 days, moving in an elliptical orbit with the Earth at one focus. Therefore, the distance between moon and Earth is constantly changing, and the tidal range changes in consonance.

5. The moon's orbit lies in a plane which is inclined to that of Earth's equator. Twice each month, the moon is momentarily in the plane of Earth's equator. At all other times, the moon will be varying distances north or south of the equator. This north-south motion of the moon causes what we call *diurnal* (daily) inequality in the tides: when the moon is in the plane of the equator, the two tides at any one place for that day will have the same range; when the moon is north or south of the equator, the range of the two tides for a day will be unequal.

6. Changes in the relative positions of Earth and sun result in cyclical changes in the component of the tide resulting from the sun's attraction. These changes are similar to those already described, but their magnitude is less and their periods are longer, being semi-annual instead of fortnightly.

Other combinations of the astronomical tide-producing forces, in addition to those just mentioned, have periods of from half a month to a year. Moreover, the range of the tide is affected by the slow change of the inclination of the plane of the moon's orbit to the plane of Earth's equator which has a cycle of 18.5 years. To arrive at a reliable mean value for mean low-water, mean high-water, or other tidal datums, we need to observe the tide for almost 19 years. Fortunately, these long-term observations need to be done only at a limited number of control stations.

Effect of the Major Ocean Basins

While the gravitational pull of the sun and moon supply the force that produces our tides, the average depth and the shape of the ocean basin influence the characteristics of the tide at any place. These characteristics, as observed on all coasts of the world, can best be explained on the assumption that the waters of the oceans naturally divide themselves into large ocean basins. Each basin has its own natural period of oscillation and is acted upon in regular periods by the forces imposed by the sun and moon. The resulting tide in the basin will depend on the relation between the natural period of the basin and the period of the forces imposed by the sun and the moon.

Effect of Bays and Estuaries

The astronomic forces and the shape of the ocean basins determine the characteristics of the true ocean tide. These factors are fixed and unchanging. The bays and estuaries along our coast must also be considered as tidal basins. The range of the tide at any place along the shore will be influenced by the topography of the bottom, by the shape of the basin, by river runoff, by the size of the inlets controlling the movement of the ocean tides in and out of the bay, and by other factors. These factors do change and, consequently, the character of the tides in bays and estuaries, unlike that of the ocean basins, can and often does change. The tidal regime in a bay or estuary can vary because of man-made changes such as dredging of channels or because of natural changes such as silting or the closing or opening of inlets.

Meteorological Effects

Wind and barometric pressure also affect sea level and, consequently, the elevations of high water and low water. For example, a strong onshore wind continuing for several days may elevate the water along the coast several feet. Variations in barometric pressure also cause fluctuations in sea level. These meteorological effects are changeable and unpredictable. They account, to a degree, for the variations in mean sea level and other tidal datums that occur from day-to-day and month-to-month. Meteorological factors, however, are well smoothed out or eliminated from tidal datums determined from 19 years observations.

Tidal Datums

Sea Level and Mean Sea Level

Mean sea level is the basic tidal datum plane above and below which the tides oscillate. Unlike the other tidal datums, mean sea level is an equipotential or level surface at least for any fairly large area. A distinction must be made, however, between the terms *sea level* and

mean sea level. Sea level is a general term meaning the level of the sea at any particular time.

We also use the terms *daily sea level*, *monthly sea level*, and *yearly sea level* to refer to the mean level of the sea determined by averaging the heights of the water for a day, a month, or a year. At any point on the coast, sea level varies from day to day, from month to month, and from year to year. From one day to the next, sea level may vary by a foot or more. Monthly sea level for two months in a year may differ by as much as a foot. The yearly sea level may differ by as much as one or two-tenths of a foot from one year to the next. These variations indicate the necessity for a mean value based on long-term observations. Thus, we have the very specific term *mean sea level* which is the elevation of the mean level of the sea at any place determined, either directly or indirectly, by averaging the heights of all stages of the tide over a long period, usually 19 years. This would correspond to the level of the sea if there were no tidal movement.

Study of the records of tide observations made over long periods, at least 40 years and at some places for over 60 years, shows that secular changes have been taking place in the relation of sea level to the land. The latest determinations show that on the Atlantic coast the relative rise of the sea to the land has been about 0.011 foot per year. The rate of the rise of the sea in relation to the land along the Gulf coast of Florida has been about 0.011 foot per year, but at Galveston, Texas, the rate has been 0.021 foot per year. On the Pacific coast, the relative rise of the sea has been 0.005 foot per year, except for southeastern Alaska where sea level has been falling at a rate of roughly 0.05 foot per year.

These secular changes make it necessary to define the datum of mean sea level and the other tidal datums in terms of a specific group of years. In 1960 the Coast and Geodetic Survey adopted the epoch 1941 to 1959 for the determination of tidal datums.

Mean High-Water, Mean Low-Water, and Mean Range

High water is the maximum height reached by each rising tide. Low water is a minimum height reached by each falling tide. The range of the tide is the vertical distance between the high water and the preceding or following low water. The range of the tide at any place varies from day-to-day, from month-to-month, and from year-to-year the same as does sea level. Thus, we need long-period mean values for our datums to determine property boundaries.

The mean high-water at any place is the elevation of the mean level of high water determined, either directly or indirectly, by averaging the height of all the high waters at that place over a period of 19 years. Similarly, the mean low-water at any place is the mean level of low water determined, directly or indirectly, by averaging the heights of all the low waters at that place over a period of 19 years.

The range of the tide and, consequently, the elevations of mean low-water and mean high-water vary greatly from place to place. Thus the surfaces of mean low-water and mean high-water are sloping surfaces and do not comprise continuous level surfaces for appreciable areas as does the mean sea-level surface. This difference in range is particularly noticeable between the open coast and the waters of nearby bays and inlets. This variation in range of the tide from place-to-place is extremely important in providing proper tidal datums for boundary and other purposes. It means that these datums have to be established at a great many places and not at just a few places along the coast.

Fortunately, we do not have to observe the tides for 19 years at each place where we need to establish tidal datums. The Coast and Geodetic Survey began studying and observing the tides about 1830. At present it maintains control tide stations with tide gauges in continuous operation at more than 100 places around the coasts of the United States and its territories. Some of the stations have been in continuous operation for more than 60 years. These control tide stations provide the basic data for establishing datums in many subordinate locations by short-term tide observations.

In general, satisfactory tidal datums can be established by one year of observation (Figures 5 and 6). In some circumstances, one month of observation will suffice. These observations are then reduced to 19-year values by conparison with a control tide station situated where the tides have similar characteristics. Usually, 13 months of observation will establish a tidal datum with a vertical accuracy of $\pm$0.20 foot or better.

Types of Tides

Atlantic Coast Tides

On the Atlantic coast, we have semidiurnal tides. That is, there are two low waters and two high waters in each tidal day of 24 hours, 50 minutes with relatively small inequality in the successive high-water heights or the successive low-water heights. Our principal datums for boundary purposes on this coast are mean high-water and mean low-water.

Pacific Coast Tides

On the Pacific coast the mixed type of tide prevails. There are two low waters in each tidal day, but there is a relatively large inequality between the successive high-water heights and the successive low-water heights. Two low-water datums and two high-water datums are defined as follows.

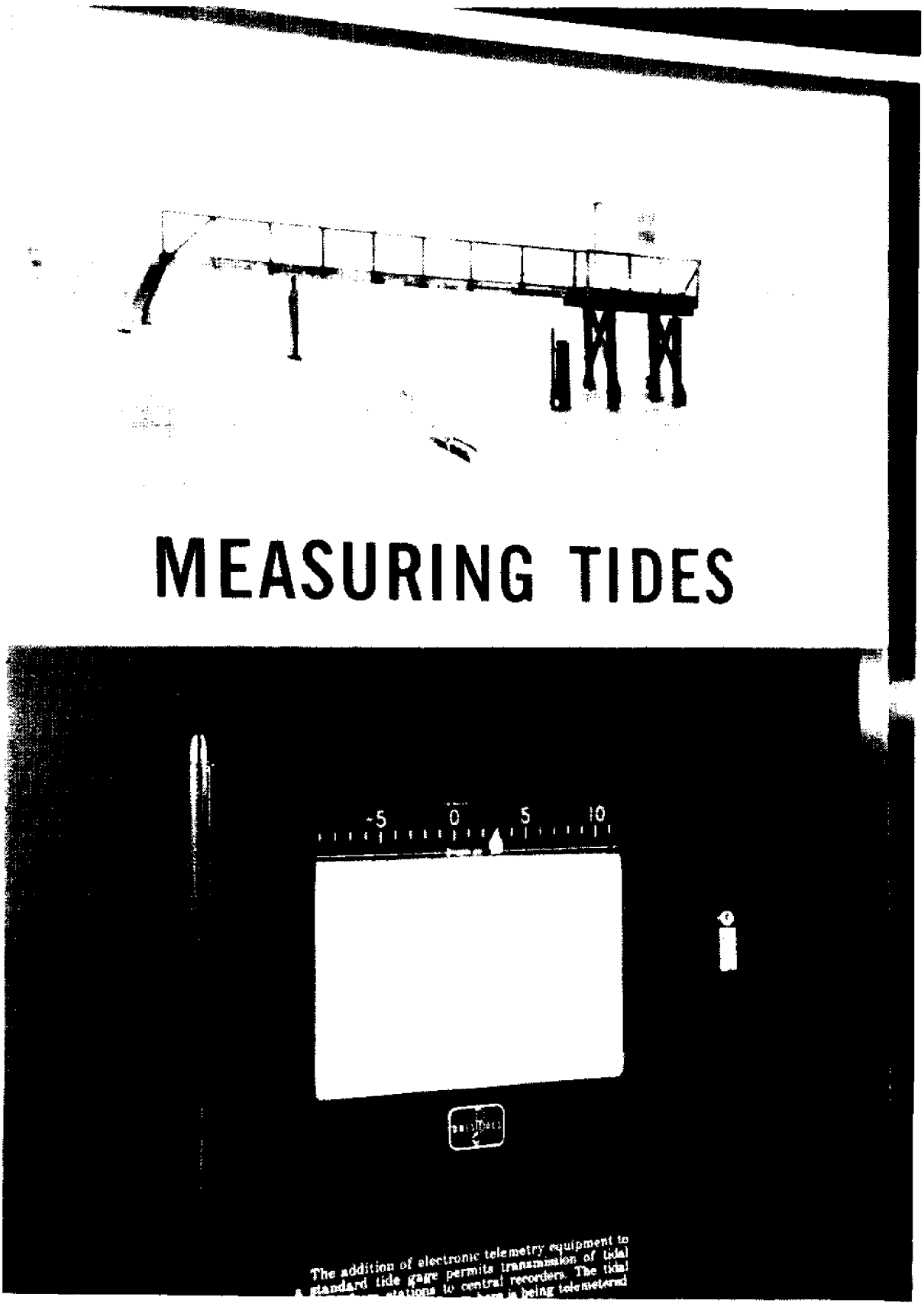

Figure 5. Tide measuring device giving readout of the tide datum for the particular area shown at top

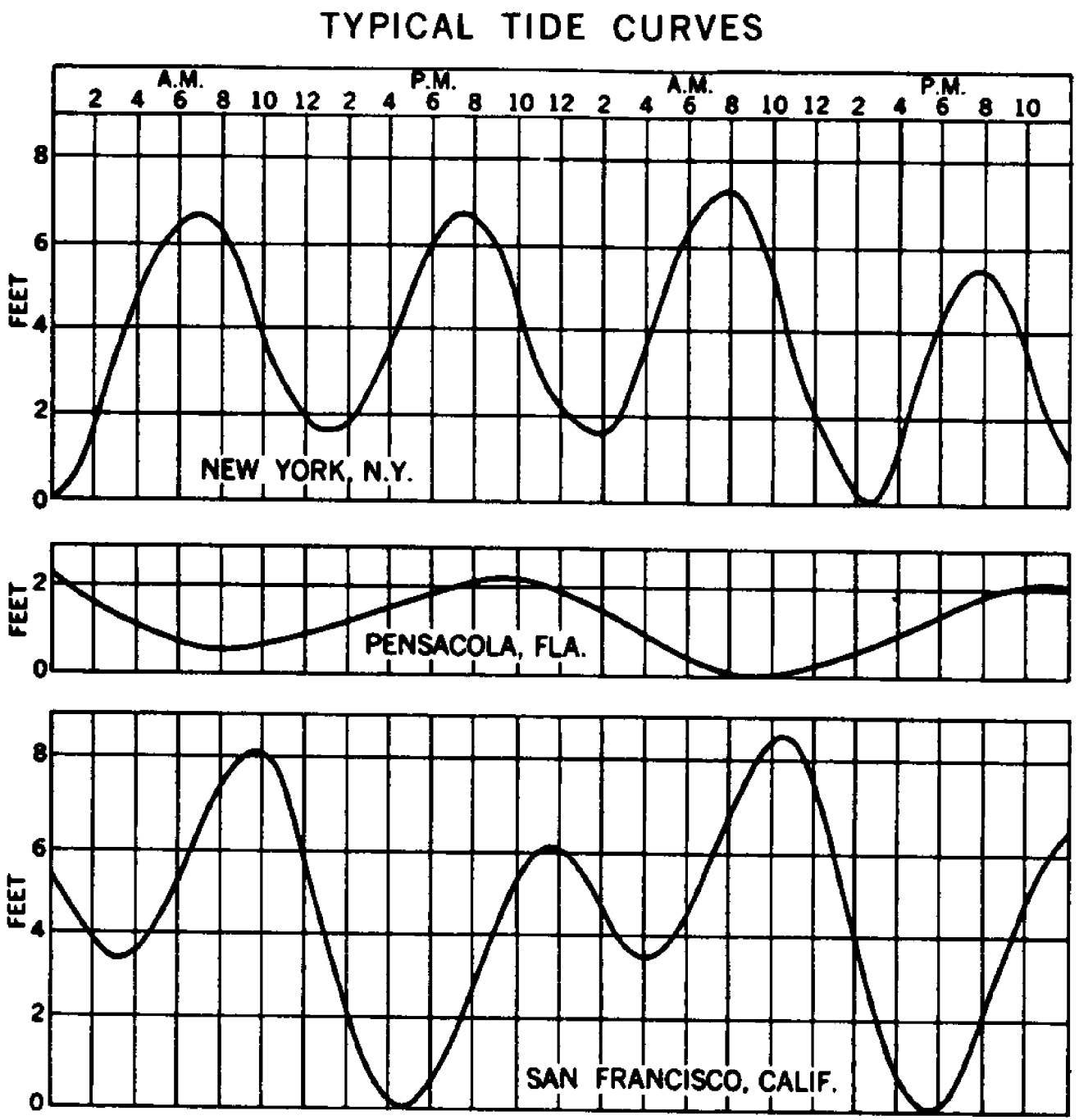

Figure 6. Example of tidal curves based on various tidal datum taken over a period of time for a given area.

1. Mean low-water is the mean of all the low waters,

2. Mean lower low-water is the mean of only the lower low-waters,

3. Mean high-water is the mean of all the high water,

4. Mean higher high-water is the mean of only the higher high-waters.

Gulf Coast Tides

Along our Gulf coast (Figure 7), with the exception of two areas in Florida in the vicinity of Cedar Keys and Naples, the tides are predominantly diurnal. There is usually but one low water and one high water in a tidal day. The tides are not, however, completely diurnal throughout the lunar month. There are days during the month, varying in number from one locality to another, when there will be two low waters and two high waters in a tidal day but with a very large inequality between the heights of the successive high waters and the heights of the successive low waters (often with little difference in height between a higher low-water and a following lower high-water).

The fact that the tides are predominantly diurnal raised perplexing questions regarding the determination of the tidal datums of mean low-water and high-water along the Gulf Coast. Should all the low waters or only the predominant diurnal low waters be averaged in determining mean low-water? Should all the high waters or only the predominant diurnal high waters be averaged in determining mean high-water?

These questions had not been critical in the computation of datums for nautical charting but became extremely important in determining the datums of mean low-water and mean high-water for boundary and engineering purposes. Consequently, in 1960, the Coast and Geodetic Survey decided to use only the predominant diurnal tides in computing the mean low-water and mean high-water datums and to ignore the secondary semidiurnal tides. The mean high-water datum is determined by averaging only the higher high-waters and by ignoring the secondary, or lower, high-waters. An exception to this procedure is made, of course, for the two areas previously mentioned on the Florida Coast where the tides are essentially semidiurnal.

The bureau came to this decision about Gulf coast tides because of two primary considerations. First it would be statistically unsound to use the semidiurnal tides because of the large inequalities and because they occur only on certain days of the month. Second, although the tides vary somewhat from place-to-place along the Gulf coast, it was highly desirable to have a consistent treatment for the entire Gulf Coast area.

The Gulf States have in the past used several tidal datums for defining the shore boundary of private property. These have included mean high-water, mean lower high-water, and mean higher high-water.

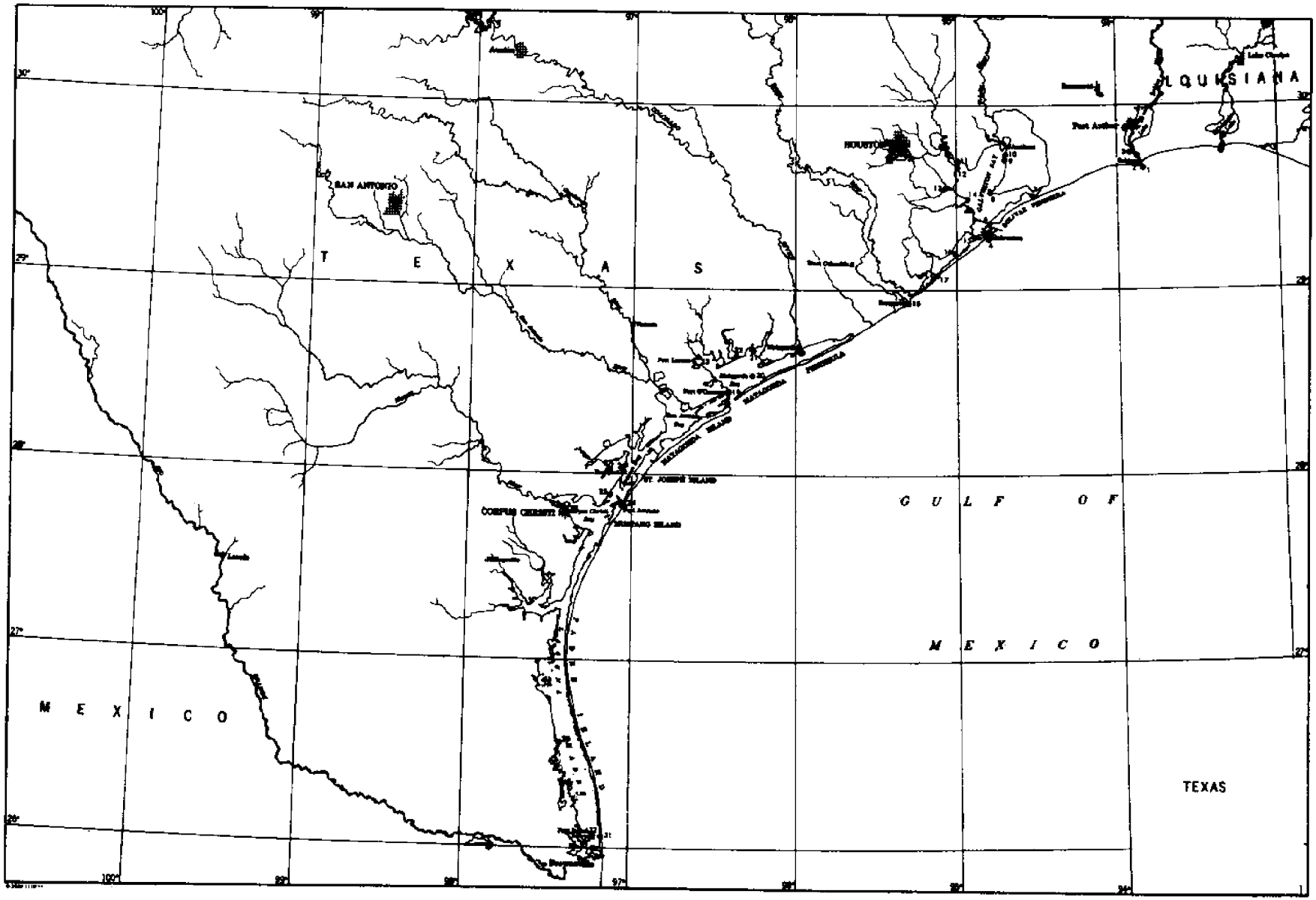

Figure 7. Texas Gulf Coast

In Texas, two high-water datums have been in use: mean high-water for boundaries falling under Texas common law and mean higher high-water for shore boundaries of properties coming down from Mexican grants prior to Texas' independence.

Actually, except for the two places in Florida, the Coast and Geodetic Survey computes only one high-water datum for the Gulf coast: mean high-water determined by averaging, either directly or indirectly, all of the diurnal high waters for 19 years. On the Gulf coast, the mean low-water line marks the seaward limit on inland waters and is the baseline for determining the offshore boundary between State and Federal mineral rights under the Submerged Lands Act.

As part of its tidal program, the Coast and Geodetic Survey has for many years operated tide gauges on the Texas Coast. Data have been obtained in the bays and Laguna Madre as well as on the outer coast. There are at least six long-period stations along the Texas coast which provide control tidal datums for coastal mapping: at Sabine Pass, Galveston, Freeport, Port Aransas, the south end of Padre Island, and Port Isabel. Range of tide varies from about 2 feet on the outer coast to 0.1 foot in some of the inside bays. There is a range of about one foot in Galveston Bay and an average range of less than 0.5 foot in Laguna Madre.

An observed daily range of 0.2 foot or less indicates that water level changes are caused by weather conditions and not by periodic tidal fluctuations. In areas where this small range exists, mean water level is the only plane accurately determinable. This creates a problem when boundary questions involving other datums arise. Special tidal analyses must be done so that reasonably accurate values for the mean high- and low-water datums can be obtained.

Demarcation of Tidal Boundaries

With the vertical component established, it is necessary to map the intersection of the tidal datum with the land in its true horizontal position by referring to markers on the shore, physical features on land, or preferably, a standard State government coordinate system.

Survey of Small Areas

When the tidal datum (the elevation of a specified tidal plane such as mean low-water) has been established and referenced to bench marks, finding, mapping, and demarcation of the tidal boundary can be accomplished by standard survey practices. The surveyor starts from a bench mark and traces out the contour, such as the mean high-water line or the mean low-water line, by using a planetable, transit and tape, or transit and stadia supplemented as need be by spirit leveling.

The survey of a tidal boundary in a marsh or swamp area usually presents a special problem. The mean high-water line is often covered with grass or other vegetation and cannot be seen readily. This fact makes the survey more difficult and expensive, but not impracticable.

Tide-Controlled Infrared Photography

Tide-controlled infrared aerial photography provides the best means of mapping the boundary baseline for large areas. After the tidal datum has been established, observers at the tide stations have radio communication with the photographic aircraft and can notify the aircrew when the water surface is at the datum elevation. Infrared photographs are then taken at the correct water level (as, for example, mean low-water or mean high-water). These show the line of intersection of the water with the land very clearly, and this line is mapped by photogrammetric methods.

Infrared photography utilizes the *near* infrared portion of the electromagnetic spectrum (wave length range of 700 to 900 millimicrons). It has a special characteristic of rendering water areas black. This is due to an increase in the absorption of electromagnetic energy by water as the wave length increases with an abrupt increase in absorption at 700 millimicrons. Thus, an infrared photograph provides a sharp, well-defined line of contrast between land and water.

The techniques of obtaining quality infrared photography are somewhat different than those for panchromatic photography. Special attention must be given to the selection of the camera, the storage of unexposed film, exposure, and processing. In addition, tide-controlled aerial photography must be accomplished on days when the tide reaches the proper level during daylight--and when the sky is cloud-free or nearly so. These are rather difficult conditions to meet, and consequently, tide-controlled photogrpahy is more time-consuming and expensive than most aerial photography. An observer is required at each tide station that controls any part of the area to be photographed, and these observers must have radio communication with one another and with the aircraft. If several tide stations are involved, it is better to use one station as the command station. All other tide observers report to the command station and the latter instructs the flight crew. The command station must have a duplicate of the flight map showing numbered flight lines and the area controlled by each tide station. Predicted tide curves are used to plan the operation.

The first step in mapping by tide-controlled photography is to recover or establish the tide stations and to lay out on the flight maps the section of coastline controlled by each tide station. One tide station will control many miles of a generally straight coastline. For example, four tide stations probably will be adequate to control the photography for the entire outer coast of Texas. On the other hand, it was necessary to use eight tide stations for tide-controlled photography of the outer shoreline of the Mississippi delta. And a few years ago, we had to use nine stations for tide-controlled photography of the shoreline around Nantucket Sound, Massachusetts.

Although tide staffs may suffice at most of the tide stations, an automatic tide gauge is desirable at the command station. This station must begin its operations well ahead of the time of photography. The first item of work at the station is to examine the tide curve for the preceding six or eight hours and to project the curve to obtain the best estimate of the time when the day's tide will be at the datum level. This time will vary from the predicted time because of local wind conditions. The command station can then tell the aircraft when to arrive and in what order the lines are to be flown. The flight crew must keep an accurate record of the time of starting and finishing of each line to correlate the time of the photography with the tide records.

The period of photography is very short for any one tide. For example, on any given day, the low tide will either not get as low as the datum or it will go below the datum. The tide rarely goes exactly to the datum level and stops there for a time. Consequently, mean low-water photography is taken when the falling tide crosses the datum level or when the tide, having fallen below the datum level, crosses that level again on the rise. These periods are very short. Because it is difficult to photograph all the shoreline at exactly the datum level, it is usually necessary to take several sets of photographs slightly above and slightly below the datum level. Then an accurate interpolation can be made from the photographs taken just below and just above that level.

Some field examination of the tide-controlled photography, or of the maps compiled from that photography, is necessary to be sure that no small features have failed to show on the photography, to check the elevations of small off-lying rocks or bars whose tops happen to be at or very close to the datum level, and to examine any sections of the datum line that may have been difficult to interpret from the photographs. This field inspection should be made with the tide at or close to the datum level and, consequently, must also be tide controlled.

Horizontal control should be panelled before the aerial photography so that accurate positions can be obtained by photogrammetric techniques. The maps are prepared by employing precise stereoscopic plotters.

Adequate tidal datums have already been established for much of the outer coast of the contiguous United States. Many of the tide stations established in the past have been connected to the primary leveling network so that the tidal datum at any place along much of our coastline can be established by level connections to tidal bench marks or to the primary level network.

Accuracy Requirements

The accuracy requirements for the realistic and economic establishment of the boundary baseline must be considered. The accuracy requirement for the vertical component, the tidal datum, depends on the slope of the beach or foreshore and the immediate offshore area. The minimum degree

of slope within the area to be mapped is the deciding factor. For example, in Louisiana there are places where the foreshore is over 3,000 feet wide with a tide range of only 1.25 feet. In this situation, the tides were observed for over a year to establish the datum within 0.1 of a foot vertically. On much of our outer coasts, however, the beaches are much steeper than this. If the foreshore, for example, has a slope of 5.0 degrees, then an error in the tidal datums of 0.2 foot will cause a horizontal displacement of the normal baseline of about 2.25 feet.

For horizontal accuracy, a mapping scale of 1:20,000 is more than adequate for positioning the boundary baseline. At this scale, 0.01 inch on the map--the approximate width of the line marking the boundary--represents 15 feet on the ground. When we consider the difficulties in establishing the datum and mapping the contact line along an irregular line often affected by surf action, this scale and accuracy will suffice for practical purposes.

Conclusion

An important function of the Coast and Geodetic Survey is the dissemination of its technical information which is meticulously collected, analyzed, and compiled in the form of charts, maps, and literature. We welcome your questions about tidal datums, tidal boundaries and interpretation of our survey records and are glad to assist in the resolution of special problems.

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LEGAL ASPECTS ASSOCIATED WITH INSURANCE ON THE COASTAL MARGIN

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The first step in discussing the legal aspects associated with insurance on the coastal margin would seem to be the determination of the sources of the applicable law. It seems obvious from the outset that State and Federal jurisprudence must be applied beyond the shoreline. The Federal statutes on the subject are found in Title 43 U.S. Code beginning at Section 1301. Basically, they provide that State ownership and jurisdiction is applicable, first to all land covered by non-tidal waters, and second, seaward to a distance of three miles plus a distance of up to three marine leagues into the Gulf, *provided* such was the boundary prior to statehood.

This land within the boundaries of the State is referred to as *lands beneath navigable waters* and was fixed by court decision at three marine leagues or 10.35 miles for Texas (*U.S. vs. Louisiana, et. al.*, 363 US 1, 4 L.Ed. 2d 1025, 80 S.Ct. 961 [1960]) and Florida (*U.S. vs. Florida, et. al.*, 363 U.S. 121, 4 L.Ed. 2d 1096, 80 S.Ct. 1026 [1960]) and limited to the three geographical miles for the other states (*U.S. vs. La., supra.*). It must be recognized that no agreement has been reached between the Gulf states and the Federal government as to the point from which these measurements start. The case between Texas and the United States is pending before the Supreme Court. Therefore, any policy with a politically described geographical limit should be scrutinized to ascertain that the operations are to be conducted, or the property is to be located, within the proper area.

Beyond the mentioned limits, the jurisdiction, power, and control of the Outer Continental Shelf is exclusively federal. The act, 43 USC 1331, defines the *Outer Continental Shelf* as all submerged lands lying seaward of the State's boundaries, "of which the subsoil and seabed appertain to the United States and are subject to its jurisdiction and control." Physically, as opposed to politically, the outer limit is

generally considered to be the 100-fathom curve. As our technology grows and operations in deeper water become possible, the practical and political limits can be expected to move farther offshore.

Thus, regarding the area from the shoreline--wherever that may finally be established--to the State boundary, State law will be applicable, including of course State insurance codes.

Dual Jurisprudence

Concerning the area seaward from the State boundary to the edge of the shelf (the 100-fathom curve), the statute 43 USC 1333 provides dual jurisprudence.

> "The constitution and laws and civil and political jurisdiction of the United States are extended to the subsoil and seabed of the Outer Continental Shelf and to all artificial islands and fixed structures which may be erected thereon for the purpose of exploring for, developing, removing, and transporting resources therefrom to the same extent as if the Outer Continental Shelf were an area of exclusive Federal jurisdiction located within a State. To the extent that they are applicable and not inconsistent with this subchapter or with other Federal laws and regulations of the Secretary now in effect or hereafter adopted, the civil and criminal laws of each adjacent State as of August 7, 1953, are declared to be the law of the United States for that portion of the subsoil and seabed of the Outer Continental Shelf, and artificial islands and fixed structures erected thereon, which would be within the area of the State if its boundaries were extended seaward to the outer margin of the Outer Continental Shelf, ..."

Query: Will amendments after August 7, 1953, to then-existing statutes or new acts passed by State legislatures after that date be effective and enforceable as "the law of the United States"?

Jurisdiction for the enforcement of all applicable law, State and Federal, is given to the appropriate officers and courts of the United States. It is further provided that:

> "The United States district courts shall have original jurisdiction of cases and controversies arising out of or in connection with any operations conducted on the Outer Continental Shelf for the purpose of exploring for, developing, removing or transporting by pipeline the natural resources, or involving rights to the natural resources of the subsoil and seabed of the Outer Continental Shelf, and proceedings with respect to any such case or

> controversy may be instituted in the judicial district in which any defendant resides or may be found, or in the judicial district of the adjacent State nearest the place where the cause of action arose." *43 USC 1333*

As you can see, both jurisdiction and venue are covered in this portion of the act. It also provides that the President is to fix the location of the States' lateral boundaries from the States' shoreline boundary to the edge of the Continental Shelf. This apparently has not yet been done.

Having determined more or less the areas of operation of the State and Federal systems of law, the forum for enforcement, State boundaries, etc., what body of Federal law do we look to when that jurisprudence is applicable? The act is no aid to us in this area. However, the Fifth Circuit Court of Appeals answered the question in 1961 in *Pure Oil Co. vs. Snipes*, 293 F2d 60 (C. A. 5, 1961). After a review of the act, dissection of its language, and peeking into the mind of Congress, Judge John R. Brown concluded that when federal law is to be applied, it is to be "the pervasive maritime law of the United States." In the area of insurance, with a single exception so far as I am aware, this law is entirely decisional. This is not true of the State law, of course. Each State contiguous to the Gulf has some statutory scheme, more or less detailed, for the regulation and interpretation of insurance.

Insurance When State Law Applies

There are some areas in which state law will apparently be applicable. The first area is coverage. So far as insurance is concerned, this is the bedrock question: Is the risk, loss, or event insured by the contract? Until 1955, the bar and bench felt with certainty that where this question arose the bar could, with confidence so far as marine coverages were concerned, look to the General Maritime Law of the United States as it has been promulgated by the Federal courts. And when that law was silent, the bar could then look to the British Marine Insurance Act and the decisions of the British courts. Although the British laws are not binding in the United States, they are considered very respectable precedents.

However, in 1955 the United States Supreme Court dropped a bomb into the area, shaking both bench and bar. The bomb was *Wilburn Boat Co. vs. Fireman's Fund Ins. Co.*, 348 U.S. 310. Until that time, it had been axiomatic in marine insurance law that a breach of warranty by the insured forfeited the coverage regardless of whether such breach had any causal relationship to the loss. The Wilburns had breached both the ownership and use warranties in their policy and thereafter the boat was lost by fire. The Texas Insurance Code contains an article to the effect that in fire losses a breach of warranty does not nullify the policy unless the breach contributed to the loss. The trial court and the Fifth Circuit Court held the Texas statute inapplicable and denied recovery under the policy.

On *certiorari*, the Supreme Court rode off in all directions. The majority reversed the decision and remanded the case to the trial court with instructions to apply "appropriate state law." Apparently the rationale was that the Federal government has left much regulatory power in the States. Congress has not spoken on this subject.

Even though the Supreme Court had not declared a controlling Federal admiralty rule, the lower courts had faithfully followed the rule for many, many years. Consequently, the holding was that the State law relative to insurance warranties would govern unless the court were to then and there declare such a controlling rule. This the court declined to do. Justice Black stated for the majority:

> ". . . There are a number of . . . possible rules from which this court could fashion one for admiralty. But such a choice involves varied policy considerations and is obviously one which Congress is peculiarly suited to make. And we decline to undertake the task."

The net result of the decision has been confusion compounded. Some writers have described it as "nightmarish." In dealing with coverage questions on marine policies today you must first determine under applicable conflicts-rules the law which governs the contract, and look to the statutory and decisional law of that jurisdiction as well as to the federal general maritime law to see if the two are in harmony or conflict. The Supreme Court has not spoken on the subject. If *Wilburn* means what it seems to mean, an applicable State statute will apparently control--if there is one. In a conflict between State decisional law and decisional law of the United States District Courts in admiralty, it is hoped that the latter rule will prevail.

There are two apparent solutions to the problem: first, for Congress to act as suggested by the court; second, for *Wilburn* to be so narrowly construed that much of its force will be lost. So far, in view of Congressional silence, we hope for the second course to be followed. As the matter stands today, State law plays an important part in designing coverage for operation on the coastal margin as well as in determining the rights of the parties when a loss occurs.

In some areas, state law will be the dominant system despite Federal court decisions that seem to indicate otherwise. One such area is in bonding, performance bonds and the like. It is certainly understandable when a contractor undertakes to construct or repair a facility on the coastal margin, the owner will require a bond.

There is also the question of completed-operations coverages which could well fall under the general heading of bonding. It would seem that most Federal decisional law in this area would be of the *Erie* type in any event and thus the States have covered the subject to the exclusion of independent Federal jurisprudence. Also under this heading would fall fidelity bonds if we ever get to the point of underwater banking. Criminal laws of the States where they may touch on various aspects of insurance would also be applicable.

Owners', landlords' and tenants' coverage could conceivably be necessary if dwellings or other structures such as undersea vacation or tourist structures are ever built. These contracts would undoubtedly be governed by the law of the State in which the building was built.

Insurance When Federal Law Applies

In some areas Federal law will apparently be applicable. One of the most important and basic of such areas is coverage. We have already discussed the impact of *Wilburn*. If this decision has limited influence, we will then look as we did prior to 1955 to the judge-fashioned general maritime law of the United States and to the decisions of other recognized systems of admiralty and maritime jurisprudence, primarily the British.

It is most likely that in the general areas of coverage interpretation, and thus in policy design, the Federal law will continue to dominate. The insurance industry, as well as the bench and bar, in this country has operated with imagination and flexibility within a well-defined framework to provide the marine operator with the kinds of insurance protection needed. We hope this proven system can and will continue serving such needs.

Personal Injury

Another area in which Federal law will be paramount is that of personal injury. Beginning with some fairly well-defined concepts based upon court-made and Congressionally-enacted law, this area has expanded to the extent that an entire day's discussion could well be devoted to it alone. However, it may be helpful to point up some of the areas in which problems now exist and may arise.

Title 1 USC Section 3 defines a vessel as including: *"every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water."* Probably, although no decision so stating has been found, *on water* also means *in water*. It could well be, therefore, that manned diving bells and other such equipment, although only used for vertical transportation, could be considered as *vessels*. If so, then the present forms of insurance applicable for protection against personal injuries, the well-known forms of protection and indemnity coverage, would suffice.

The philosophical interplay between law and insurance in this area has been a result of the law impressing a duty or obligation upon the entrepreneur which he has been unable to carry along and has thus paid others to help him shoulder the burden. Generally apeaking, insurance has been a remedial tool and has not been anticipatory.

Although we may speculate upon what course the law may take in imposing such burdens and also speculate upon the need for certain types of coverages, the best we can do is to be prepared to meet the needs as they arise. If the industries operating in the marine environment will keep lawyers abreast of the areas into which they may advance and lawyers in turn will use imagination to speculate upon possible areas in which insurance will be needed and advise the insurance industry, perhaps long delays in meeting the needs can be avoided. These comments are, of course, applicable not only to personal injury losses, but to all types of insurance needs on the coastal margin.

To a degree, the area of personal injuries on fixed structures has been covered--so far as insurance needs are concerned--by Federal legislation. The earlier quoted portion of 43 USC 1333 giving the United States courts jurisdiction of cases and controversies arising out of any operations conducted on the Outer Continental Shelf is amplified by the next section of the act which extends to such operations the Longshoremen and Harbor Workers' Compensation Act.

Two points are of particular interest. First, the language of the statute deals with *artificial islands* and *fixed structures* on the Outer Continental Shelf. Such language is certainly capable of the interpretation that these fixed structures may be subsurface. Second, the act deals only with employees engaged in exploration, development, and transportation of mineral resources. Consequently, it has to be assumed that a waiter in an underwater restaurant constructed on the Continental Shelf beyond the boundaries of a State would be covered under some compensation scheme other than the Longshoremen's Act.

No point is to be gained in further speculation and everyone can supply many additional examples of problem areas. Since such problems might arise beyond the boundaries of a state, there are two possible solutions: additional legislation by Congress or following the applicable state statutes.

To be properly insured, of course, the fixed structure owner must have coverage properly designed to protect against injuries to people other than his own employees.

As to the artificial islands, we should be able to accurately predict that to the extent they may be changed in form and purpose from the presently well-known petroleum installations, both law and insurance will develop along the guidelines already established in the petroleum industry.

Another area of importance in the personal injury field will be accidents occurring beneath the sea's surface. People are going beneath the surface in three general ways: as divers; in self-propelled, fully mobile submarines; or in some type of diving bell lowered from a mother ship or structure. They may also remain beneath the surface for indefinite periods in either a permanently fixed habitat or in a temporarily located one.

In 1965 in *Smith vs. Brown & Root, et. al.*, 243 F. Supp. 130 ([USDC WD La.] aff'd *per curia* 376 F2d 852 [C.A. 5, 1967]), a diver was entitled to the seaman's traditional and statutory protections. Consequently, it would behoove those who employ divers, whether directly or indirectly, to be certain when such men are operating from either surface or subsurface vessels that their insurance protects against seamen's claims.

In the same case, the now familiar Ryan Doctrine of implied warranty of workmanlike service and its attendant indemnity obligations was applicable between the diver's employer and the owner of the vessel from which the diver was operating. Thus, the employer should have adequate coverage in the general liability area.

It is probably accurate to say that all people who go to sea or beneath the sea in fully mobile, self-propelled submarines will be considered by the courts as members of the crew and entitled to the same protections as the crew of any surface vessel. Because of the hazards in underwater operations, high standards and more stringent obligations may be imposed upon the owners and operators of such vessels.

I am told by the owners of private submarines, such as Reynolds Metals' *Aluminaut*, that protection and indemnity coverage on their subsurface vessels is written on exactly the same form as for their surface vessels. As undersea craft proliferate in the private sector, we can expect some modification of obligations and correlative modifications of insurance contracts.

It is in the area of underwater personnel in either permanently fixed quarters or mobile ones that we will undoubtedly see the greatest growth and change in the legal obligations and insurance contracts. Imagination can run riot regarding the forms such obligations may take and how the burdens will be shared through insurance contracts. Study, research and publication by organizations such as Gulf Universities Research Corporation will influence the course taken by the law and by the insurance industry. If a prediction can be permitted, it would be that such obligations, rights, and duties will be of a distinctly maritime flavor, will be more stringent than those applied to equivalent operations or occupations on the land, and will be Federally fashioned.

Property Damage

Federal law is also going to be of vital importance in the area of property damage. The insurance applicable to surface craft operating in the coastal margin is well known and well defined. The common coverage is provided by one or more of the various forms of hull insurance. In the American insurance market the basic type is known as the American Institute Time Hulls form. In 1966 this form was the subject of a two-day symposium at the Tulane University Law School. It is, therefore, obviously impossible to cover it in depth in the space allotted here. It should be recognized, however, that the legal relationships devolved from this contract are long-standing and well defined with the exception of the problems created by *Wilburn*.

Hull coverage for privately owned submarines is currently being furnished on the same forms as for surface vessels. With the number of these vessels increasing, rates have fallen as underwriters have become more familiar with the risks and have had a greater spread. However, with the increased numbers of such vessels operating there are obviously going to be new rules relative to underseas navigation with its three dimensional possibilities. The new liabilities will call for a corresponding change in insurance forms. The legal profession and those sciences and agencies dealing with navigational hazards will all have to work in harmony to devise and guide those changes.

A great deal of experience has already been gained by the legal profession and the insurance industry with regard to surface structures in the coastal margin. The oil and gas industry pioneered the use of fixed and mobile platforms for exploration and production of mineral wealth in the sea. The insurance and legal problems associated with these structures are fairly well defined, at least in the areas of property damage. The two largest sources for such damage are the elements and collisions. As the size and complexity of such structures increases, the risks will become correspondingly large, but at this time there does not seem to be any reason to expect the applicable legal and insurance codes to be greatly modified.

It is in the area of fixed subsurface structures that new legal and insurance questions may arise. For example, it would seem quite difficult to legally adapt the present forms of fire and extended-coverage policies to a structure located in 500 feet of water. In addition, as submarine traffic for pleasure and commerce increases, undoubtedly many of the same legal problems will arise concerning fixed and mobile subsurface objects as now exists concerning fixed and mobile surface objects. These problems could well be compounded by the environment in which docking operations, cargo transfers and the like take place. What form the new obligations and covering policies might take is difficult to predict. It is easy enough, however, to recognize that the solutions to the problems will likely be extensions of the solutions already applied in surface operations.

Cargo Problems

Cargo problems on the surface of the sea, both legally and in the insurance industry, are well recognized and defined and little seems to be gained by rehashing the rules at this point. The Carriage of Goods by Sea Act and sister enactments are the governing acts and have been the subject of wide interpretation by the courts. The obligations of carriers and cargo owners have long and satisfactorily been the subject of insurance written in both the domestic and foreign markets.

Only one new interesting legal and insurance hazard has presented itself in a significant way recently. This is the problem of the growth of containerized shipment with the packaging, dunnaging, and sealing

of cargo within containers being done, before arrival at the coast, by persons with little knowledge and less experience of the hazards to which a marine shipment is subjected. When a container which was loaded and sealed in the interior of the United States is finally opened in the interior of Europe and the cargo is found to be damaged, it is impossible to pinpoint where in the multiple vehicle transit the damage occurred, what carrier is responsible, and where ultimate liability may lie. Primary responsibility of carriers' underwriters is thus confused as is the cargo insurer's subrogation picture. We shall obviously see some changes in forms of bills of lading and insurances to overcome these problems. It may well be that the genesis of such changes will have to be in Congress.

It is in the subsurface handling of cargo that perhaps the greatest innovations will be seen. New techniques will undoubtedly have to be developed, and new legal privileges and responsibilities will follow. The insurance industry will be called upon to provide protection for those upon whom the burdens fall.

The Ryan Doctrine

Some legal changes are probably in the area of indemnitee-indemnitor relations. Under this heading our attention is more directed to the relationship imposed by law as contrasted with that deliberately assumed by contract between the parties. The primary example of the former in the maritime field is the doctrine enunciated in *Ryan Stevedoring Company vs. Pan-Atlantic Steamship Company*, 350 U. S. 124 (1956).

The Ryan Doctrine has been extended to cases of divers as well as to cases of many types of maritime workers to whom the warranty of seaworthiness has applied. So far, however, the notable exception in the extension of this doctrine has been on offshore mobile drilling rigs. In two cases, *Halliburton Co. vs. Norton Drilling Co.*, 320 F.2d 431 (1962) and *Ocean Drilling & Exp. Co. vs. Berry Bros. Oilfield Service, Inc.*, 377 F.2d 511 (1967), the Fifth Circuit refused to extend the Ryan Doctrine in such cases. However, on analysis it seems that in neither case was a proper fact situation before the court for such an extension.

I believe that when a case is presented to the Fifth Circuit in which the parties are in positions clearly analogous to those of vessel owner, stevedore, and longshoreman and a floatable drilling rig is involved, the court will extend the Ryan Doctrine to these special-purpose vessels and to the people who work aboard them as service personnel. Consequently, with what I believe to be the certain liability exposure hanging over the heads of employers of service personnel for indemnity to vessel owners or operators and the increasing lack of insulation of employers from direct action by their employees (following the decision of the Supreme Court in *Reed vs. s/s YAKA*, 33 U. S. 410 [1963]), careful design of insurance coverage is necessary if an employer is not to find itself uninsured in indemnity situations.

With the expansion of industry and with higher standards to be imposed to offset the higher risks, it would seem likely that the Ryan-type warranty would be applicable in situations where it has not yet been applied. It will, therefore, be left to the growing insurance industry to design protection against new areas of loss.

Legislating for Uniformity

There will be a need for specialized craft and facilities in the burgeoning developments of the coastal margin. Economics will, therefore, dictate specialization in the creation of tools in the broadest sense. Such tools--ranging from vessels to habitats to instrumentation and even to hand tools for underwater work--will in all likelihood be furnished in large measure by service organizations, as in the oil fields special tools and services are furnished by mud companies, electric log operators, wireline service companies, etc.

Because, however, of the more hostile environment in which such tools will be used above and below the surface of the ocean as compared to the use on land and because of the increasing complexity of those used in subsurface operations, higher standards in design and maintenance will be imposed upon those who furnish them. Such standards should be uniform, at least in the guidelines. And the best vehicle for obtaining such uniformity is Federal legislation. Once these legal guidelines have been established, insurance will have to be provided.

One vital service which organizations such as Gulf Universities Research Corporation might accomplish would be to assist in the preparation of legislation and the type of insurance for activities on the coastal margin.

MINERAL AND WATER RESOURCES IN THE COASTAL MARGIN

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This chapter is limited to a basic outline of the operating framework facing the mineral entrepreneur; the problems which he faces; some of the problems of governmental relations affecting mineral exploitation; and some of the water use problems facing the coastal areas.

The Operating Framework

Securing Operating Rights

Public Lands. Under the Outer Continental Shelf Land Act, the Secretary of Interior is empowered to lease the outer continental shelf for the exploration for discovery and production of oil and gas, sulfur, and any other minerals, except source materials and helium in any area of the Outer Continental Shelf to qualified persons bidding competitively. Affected minerals in the outer continental shelf are subject only to leasing by competitive bidding. The Secretary generally is authorized to prescribe necessary rules and regulations:

1. To carry out the provisions of the act.

2. To prevent waste and promote conservation of natural resources.

3. To protect correlative rights and natural resources.

Other, more specific regulatory powers (not limiting the general powers above noted) include those:

1. To provide for assignment or relinquishment of leases,

2. To provide for the sale of royalty oil and gas.

3. To provide for unitization and pooling, and for drilling agreements.

4. To reduce rentals or royalties.

5. To suspend operation or production.

6. To make compensatory royalty payments.

7. To provide for subsurface storage of oil or gas.

8. To grant drilling or other necessary easements.

9. To grant pipeline rights of way.

10. To establish regulations for advertisements for bids and bidding.

11. To authorize geological and geophysical explorations by others and agencies of the United States.

The act fixes certain minimum terms and conditions of oil and gas, and sulfur leases and leaves additional terms and conditions of these leases as well as all terms and conditions of leases of other affected minerals within the discretion of the secretary. It also provides for the secretary's validation of leases and submerged lands of the Outer Continental Shelf issued by States prior to the act and for policing of these leases. Leases held in violation of the act's provisions or the lease, or regulations of the secretary, are subject to cancellation or forfeiture either by *administrative* action subject to judicial review in the case of non-producing leases and leases obtained by fraud or misrepresentation; or by *judicial* determination in the case of producing leases.

The Secretary of the Interior has, in fact, exercised his leasing power by delegating it to the Bureau of Land Management. Nominations are received for the leasing of specified tracts and lease sales are held periodically. The overseer of Federal offshore lease operations is the United States Geological Survey, which regulates drilling and operating procedures, unitization plans, and other operational problems.

Operating rights to state owned lands, including waterbottoms, are usually obtained by leasing under statutory structures fundamentally similar to the Outer Continental Shelf Lands Act. However, the leasing and administering agencies do vary. In Florida, responsibility is vested in the Internal Improvement Trust Fund. In Alabama, the Director of Conservation is responsible for the leasing function. In Mississippi, the State Mineral Lease Commission grants such leases. In Louisiana, leasing is the responsibility of the State Mineral Board, and in Texas,

leases are granted by the School Land Board. In Florida, the administrative function is assigned to its conservation body, and in Texas, administration is accomplished through the Commissioner of the General Land Office. In Alabama, Mississippi, and Louisiana, the legislative structures provide for leasing rights for the development of all minerals. However, in Florida legislation provides for sale of hard minerals in place, and in Texas special provision is made for hard mineral exploration permits with a preferential leasing right upon commercial discovery.

In addition to the leasing of state-owned lands, there is a wide variation of statutory provisions under which leasing by State agencies or subdivisions may take place. These statutes or procedures are not stated here, but they are an important part of the legal structure within which the mineral operator must work in the coastal margin.

Private lands. Although the private property laws of the various states on the Gulf of Mexico differ in some respects, the lease is the basic means by which the more important mineral operating rights are acquired. The mineral lease is a highly-evolved and complex contract, and although problems of interpretation and application frequently arise, the applicable private law is well established and, for the most part, clear. In the case of some of the less important minerals in the coastal area, i.e., sand, gravel, or shell, sales of these resources in place do occur, but the lease remains the basic mineral development contract.

Government Regulation

The large number of regulatory structures affecting the mineral operator in coastal areas must be noted as a part of the operating environment, but, again, it is possible only to sketch a very broad picture.

Conservation of mineral resources. Within the areas of state jurisdiction, conservation of mineral resources (principally oil and gas) is in the hands of the various State conservation agencies, and oil and gas operations, including drilling and operating procedures, unitization, and allowables are regulated by them.

Currently, the federal government still utilizes the state regulatory structures for fixing allowables, but the Secretary of the Interior has published notice some time ago that the federal government will begin fixing allowables of its own in the Outer Continental Shelf area. Final regulations have not yet been promulgated.

Other administrative functions. There are numerous other administrative functions in utilizating mineral resources in the coastal margin. The operator has to deal with all of the administrative agencies governing the operations of any other business, but his operational efficiency is

even more affected by an administrative overburden when operating in waterbottom and offshore areas. The value of helicopters is substantial. The operator must utilize crew boats, drilling barges, tugs, and transport barges. Greater use of radio communications is required. Operation of living quarters and related food service facilities is necessary. Structures must be erected in navigable waters.

These characteristics of operations in the coastal margin compel the operator to secure necessary authorization from, and to abide by the regulations of, such agencies as the Federal Aviation Administration, the Coast Guard, the Corps of Engineers, the Bureau of Customs, the Federal Communications Commission, and others. Additionally, there are federal and state agencies exercising control over the impact of his operations on other resources and competing uses of the coastal margin. For example, he must heed regulations governing the effect of his operations on aquatic life and game. He must obey regulations on environmental pollution--both air and water.

The impact of this administrative overburden is difficult to assess, but costs could be lowered and savings realized by simplifying and centralizing the regulatory functions in the coastal area.

Employer-employee problems. Aside from the normal run of labor problems affecting all industrial enterprises, the operator in the coastal area faces some special problems and costs, particularly in areas of personal injuries to employees. Many scholars have expended energy in the effort to resolve the problem and beyond that, there are other problems of cost that should be mentioned.

Determining whether an injured employee is covered by state workmen's compensation, the Longshoremen and Harbor Workers Act, or the Jones Act rests upon incredibly esoteric distinctions. It is an unwise social policy to have three different regimes of compensation for work injuries occurring to people in the same basic industrial endeavor. Observation of the verdicts being rendered in many cases under the Jones Act, and contemplation of the fees being charged, leads one to speculate whether the public is paying too much to some workers and lawyers and not enough to others. If there is inflation in one and depression in the other, balance should be achieved. This is mentioned both as one of the problems of the operator and one for the legal planner.

Critique

The statutory structures for leasing and developing public lands were designed essentially to accommodate the oil and gas industry, though sulfur has ridden in on the back of petroleum development to a limited degree, and for the present these structures are adequate.

The major problem regarding statutory structures is whether they are sufficient to meet new mining techniques and the development of minerals other than oil, gas, and sulfur. To determine the adequacy of these

structures, however, will require a more detailed picture of what minerals are present, what inducements may be necessary to encourage development, and what extractive techniques will be involved. For the present, legislation appears to be fundamentally sound.

Private laws on mineral development in the coastal margin are basically those applicable to any upland area under private ownership. However, there are some exceptions. First, there is often greater complexity surrounding land title in the coastal margin. Problems in fixing natural boundaries, proof of acts of possession, and proof of mean high water marks make titles to swamp and marshland more precarious. Additionally, there are the problems of determining the effect of accretion, reliction, and erosion on titles.

What appears to be the major problem for the operator in the coastal margin insofar as laws directly applicable to his operations are concerned is found in what I have described as "administrative overburden". All business enterprises today face a high degree of government regulation. Some attempt should be made to do something about this drag-effect generally created by bureaucratic proliferation. But in so far as mineral operations in the coastal margin are concerned a good case exists for a more intensive, special effort. Utilization of mineral resources in marine areas is an emergent field. In addition to the persuasive argument for direct subsidies of some activities that should be given priority, an even more cogent and momentous argument can be made for simplification of regulatory systems for the offshore operator. This would not involve direct subsidy and would be economically beneficial to the public and the operator. No direct monetary outlay is required of the public. In fact savings might result from simplification of the administrative functions in the offshore area.

Some special attention to reducing the operators' higher operating costs in the coastal environment (as compared with more upland areas, excepting harsh environments such as Alaska's North Slope) is definitely needed.

Intergovernmental Relations

In addition to the problems posed by state and federal governments individually, the operators' position is further complicated by relationships between state governments, and between state governments and the federal government. Prominent among these, is the continuing boundary dispute between Louisiana and Texas and the United States. As mineral development progresses within the lateral boundaries of states, disputes will develop over respective boundaries. The Sabine Pass area on the Louisiana-Texas border is a good example of one in which dispute could arise.

A second problem is the relationship between state and federal governments in the performance of administrative functions. In certain areas or in certain administrative functions, one government may be best

equipped, by virtue of an existing administrative agency or geographical consideration, to perform an administrative function in an area within the other government's jurisdiction. Examples of cooperative efforts can be found. The United States has accepted the regulations of the Louisiana Wildlife and Fisheries Commission as to the conduct of geophysical exploration. Until recently, the United States accepted state regulations on oil allowables without question. Greater concentration now should be given to intergovernmental cooperation to increase the level of efficiency in the performance of regulatory functions.

A third problem lies in the effect of proprietary competition among governments. Mineral deposits do not, of course, follow state or state-federal boundaries. Competition for the wealth derived from mineral extraction could be destructive. The Interim Agreement of October 1954 between the State of Louisiana and the United States was successful in facilitating resumption of offshore drilling activity and preventing a crippling economic blow to the industry and local economies. While not ideal, this agreement should be a model for study to determine what can be done to avoid the destructive effects of propeietary competition.

The compelling force promoting intergovernmental cooperation is the public interest in efficient resource management. The need for cooperative effort is strong and should certainly prevail over competitive forces.

The Problem of Multiple Use

Some of the most important problems of mineral exploitation are not so much directly related to the laws immediately applicable to mineral development, such as state or federal statutory structures for granting rights in submerged land areas, as they are in the impact of mineral development on other uses of the coastal margin--and vice versa.

Currently, the principal competing uses are recreational use, agriculture, fisheries industries, commercial shipping, and other industrial uses. A growing competing use will be the intensificaiion of residential use. The potential effects of mineral operations on these competitive uses lie in four functional areas:

1. Competition for space.

2. Competition for use of, or pollution of, environmental resources.

3. Possible detrimental effects on living resources, either through pollution or by activities which cause gradual changes in the local ecology.

4. Subsidence.

Competition for Space

Competition for physical space is manifested in several ways. Erection of structures, both surface and subsurface affects the fisheries industries by creating obstructions which can damage nets and other equipment. The effect on shipping has been effectively handled by the system of fairways in the Gulf of Mexico. These conflicts have been adequately resolved, for the most part. There has been little difficulty in competition for coastal land surface, but the increasing recreational and residential uses may result in friction between the mineral industries and other users. The erection or presence of shore facilities for the processing and handling of petroleum products may have an adverse effect on the market value or use potential of coastal areas as tourist or residential centers. To date, there has been no attempt to upgrade the low esthetic values of facilities of this kind along the Gulf Coast. The beautification of the islands resulting from the THUMS venture in Long Beach, California, however, is adequate evidence that such steps are possible and that when the pressure of competitive use is sufficient, this sort of phenomenon will occur. In the future some form of zoning may be required, and standards may have to be set for construction of these facilities which will minimize the detrimental effect on recreational and residential use.

Insofar as space is concerned, present mineral operations, as well as those which are predictable, have little effect on agricultural uses. Wider well spacing and multiple-well drilling locations mean that these two activities can exist in close proximity without noticeable friction. The only form of extraction which could cause major difficulty is some type of strip mining, but there is no major activity of this kind currently causing such problems.

Competition for Environmental Resources

In the area of environmental resources the competitive forces are both qualitative and quantitative. The qualitative problems lie in the effects that mineral extraction has on water and air. Polluted air obviously lessens the desirability of a particular location for most competitive uses. To date, the process of extraction itself does not appear to have caused major problems. Refining and manufacturing segments of the petroleum industry do present a problem, but these activities are not necessarily centered in the coastal margin and are not part of the extractive process, except in a remote sense.

As to water pollution, the dangers are well known. In Louisiana and Texas, both state and federal agencies are currently exercising jurisdiction. Additionally, the leasing agencies of both state and federal governments exercise some control. The dangers of spillage and well blowouts causing pollution making water resources unusable and

destroying recreational and residential values are obvious and serious. There are both State and Federal safety regulations, but more stringent oversight is needed as the damage to recreational facilities, residences, wildlife, and fisheries can be overwhelming. Brine discharge was once a much more serious problem than at present. There is an inevitable amount of pollution occurring from present mineral extraction, but this fact should not deter efforts to present existing, avoidable pollution or to assure that disasters to coastal areas will not occur.

Quantitative competition does not presently appear to be too serious in most areas of the coastal margin where mineral extraction takes place. The danger is that extractive processes can cause shortages of ground or surface water. Some possible, but highly localized damage occurs, for example, where a water flood project damages a local ground water supply, but basically the existing extractive industries do not create a shortage problem on the coast of the Gulf of Mexico. The continued operation and growth of manufacturing elements related to mineral extraction, principally the petrochemical industry, could create a shortage problem in the future.

Competition for environmental resources centers then, on the matter of pollution of surface water. There is increasing concern and vigilance on the part of state and federal governments. The existing extractive industries can consider that regulation in this area is a part of their operational environment.

Effects on Living Resources

The possible effects of mineral extraction on living resources and their competing uses are varied. Detrimental effects stem principally from pollution, and the dangers are severe. For example, a major blowout or oil spill off the Louisiana coast could destroy a substantial amount of bird life, kill fish, pollute oyster beds, and by pollution of the shrimp breeding ground could seriously damage the ecology of a large area by killing living resources and disrupting the food chain. Several State and Federal agencies are acting in this area to prevent such occurrences, but greater vigilance is warranted.

During normal operation, the effects of the present extractive industries are not damaging, and in one important way the erection of platforms in waterbottom areas has been a positive benefit, acting as a harbor for trout, redfish, snapper, grouper, cobia, mackerel, pompano, bluefish, and other fish species. This is, of course, a benefit to recreational use--sport fishing. Interestingly enough, the catch by sport fishermen in the United States is far greater than that of the commercial fishing industry.

Subsidence

At present, the operation of the petroleum and sulfur industries has not caused a widespread problem of subsidence. The fact that this has become an acute problem in some areas of California, however, suggests that

the Gulf Coast area could become concerned with the effects of subsidence. The principal activities that are damaged are recreational users who construct private or tourist facilities, residential users, agricultural users, and other industrial users. In the future, some remedial steps may be required, and further administrative control may arise.

Critique

Of current problems the most important is the effect of mineral extraction on competitive uses and subsequent water pollution. This has, or potentially can have, serious detrimental effect on the quality of water supplies needed for industrial or domestic use and on the living resources of the coastal margin. Almost every competitive user, present or future, can be damaged seriously if controls are not effective.

The problems of competition for space are not yet acute, but may become so. It is observable that normal operations do not adversely affect living resources. And subsidence has not yet become a problem.

For the future, we must look to some form of zoning to solve the problem of competitive use. This will certainly affect the extractive industries, but the effects are not subject to calculation at the present time. It can be predicted that regulatory controls will increase. This makes it even more imperative that the present regulatory burden of the coastal and offshore mineral operator be lightened by simplification or centralization as the growing demands for use of the coastal area will certainly increase regulatory controls.

Water Resources

The availability of water resources for industrial, domestic, agricultural, and recreational use is predictably one of the biggest problems facing coastal margin in the Gulf of Mexico, and center on adequacy and quality of the supply. Subsidence, a by-product of the water problem, results from lowering ground water levels.

In an area such as the Gulf coast, with limited exceptions such as the southern coast of Texas, it seems curious that there would ever be a problem with water because the area is regarded as water-rich. Presently it is, but plans which loom on the horizon, such as that for diversion of substantial portions of the Mississippi River to Texas, the predictable growth in population and industrial activity, and the demands of upstream states make even this supposedly unlimited source of water a finite rather than an infinite source. Demands on other available streams, including the Sabine River, may make the supply problem a reality in an area which has never before worried about water shortages that the desert coastal plains have struggled with for some time. Most states are currently developing overall water plans, but the future holds the prospect of considerable interstate squabbling unless there is a sudden departure from earlier State attitudes in interstate water disputes.

Ground water supplies in the coastal margin are subject to the twin dangers of depletion and degradation. Some areas have ground water supplies under artesian pressure, but the rate or recharge may not be sufficient to prevent an overdraft when meeting increasing demands. Maintaining ground water supplies carries unquestioned advantages of inexpensive withdrawal, natural pipeline effects, natural filtering, and relative immunity from pollution resulting from natural or military disaster. Some institutional framework must be devised in most states to permit protective management. Texas already has legislation permitting the formation of ground water conservation districts. Louisiana has some individual ground water conservation projects and provisions for soil and water conservation districts, but the latter are directed toward preservation principally for agricultural uses and are inadequate to meet the problems arising over preservation of a ground water supply in an industrial area. Solving these problems inevitably involves the use of water sources, either surface or subsurface, from some other area as a means of replenishment, and in turn creates competition for some other sources. It is this competitive phenomenon that necessitates rapid development of statewide water plans.

Degradation problems are varied. Principal among them is pollution from industrial waste and sewage. State control agencies are operative in all of the Gulf Coast states, and impetus has been added to the diligence of these agencies by federal water quality legislation and the activities of the federal water pollution control agency. The effectiveness of these efforts is visible, but the adequacy is yet to be measured. The resources massed by some major users and pollutants to obfuscate the effectiveness of pollution control are large.

Pollution is the major threat to surface water supplies. Other than depletion by mining or overdraft of recharged supplies of ground water, the greatest danger to this resource is intrusion of sea water or phases of connate salt water driven downdip in aquifers charged whth fresh water. The feasibility of ground water management is somewhat limited by the applicable property theory regarding the surface owner's rights. In Texas for instance, the ownership concept has an inhibiting effect on ground water management, and thus the efforts of the Texas Water Rights Commission have concerned only surface water supplies. By comparison, the Louisiana landowner is not the owner of the ground water, and public management is not obstructed by property concepts.

In the area of ground water management, a local case study may serve to illustrate the range of problems which may be encountered. Several years ago, one of the most-used aquifers that supplied the Baton Rouge, Louisiana petrochemical complex was infiltrated by a wedge of salt water. The degradation of a high quality water supply, which is a substantial inducement to locate this type of industry in Baton Rouge and the surrounding area, created concern that other aquifers were or would become endangered and, ultimately, the adequacy of the ground water supply. One might legitimately ask why an area such as Baton Rouge is worrying about losing its ground water supply when the Mississippi River is in

its front yard. The answer lies basically in the matter of quality. The Baton Rouge ground water is pure enough that it can be used in most industrial processes without distillation. Mississippi River water does not approach this quality, and technical studies revealed that the cost of processing it would be beyond reasonable limits and still would not provide water of the quality of the present supply. Thus, threats to the quantity or quality of the ground water supply must be taken seriously.

The Louisiana Water Resources Research Institute has sponsored a research project to study the situation. The cooperation of the U. S. Geological Survey and the financial support of the city-parish government were obtained. It was known that there is a fault area running roughly from west to east across the southern portion of the city. The degree of interchange between the aquifers on the two sides and the origin of the salt water were unknown. Also unknown were the dynamics of the ground water system; whether there was any feed from beneath the river; where the recharge area, if any, was; and the effect of any faults to the north.

A comprehensive mapping program tracing the origin and continuity of the aquifers was undertaken by the geological section of the study team. The engineering section undertook a drilling program to measure the exact location, source and rate of encroachment of salt water, to determine the degree of interchange from the south side of the fault to the north, and to design models for obtaining replenishment water if this should become necessary. The economic section of the team undertook cost analyses of alternate sources, including the Mississippi River. And the legal section began looking into the problems attendant upon such possible projects as operation of scavenger wells to create a pumping depression, operation of injection wells to create a barrier against further intrusion, operation of recharge wells, acquisition of rights to a source for replenishment, and problems of financing and operating a ground water protection project.

In the latter stages of the project, evidence has been discovered of a subsidence problem in the industrial area that will reach crisis stage unless the aquifers are replenished to prevent lowering of ground water levels and consequent compaction. This is a problem which Houston and other cities in the coastal margin are facing.

The study is not complete, but it seems certain that the study team will recommend the establishment of a water conservation district which will acquire rights to take extremely high quality water from the Amite River about fifteen to twenty miles away. Spreading grounds will be acquired in an area near the site from which it is taken and it will be stored below ground for future use. Upon demand, replenishment water will be transported to the Baton Rouge area where some will be sold directly to users, some will be injected to maintain the ground water levels and some will be used to create a pressure barrier against further

intrusion of the saline phase. Studies reveal that the saltwater enters the affected aquifer from the west side of the Mississippi River, passing beneath the river and turning north toward the pumping depression in the industrial area. The existing wedge will be withdrawn by operating one or two scavenger wells, and the brackish water will be put into the Mississippi River, upon consent of the Stream Control Commission.

The effective accomplishment of this ground water management and subsidence control program requires the passage of legislation creating a ground water conservation district. One of the more interesting legal problems which must be faced, or which may crop up in the future, is the question of how to assure a steady state of supply for the district from the Amite River. Louisiana adheres to a system of riparian rights to surface waters, and it is unclear whether the natural flow theory or the reasonable use rule will be applied. Thus, there is a great uncertainty as to how the district can be assured of the right to take a given amount of water each year. Certainly, the issuance of revenue bonds to cover the cost of investment will depend on a solution to this problem.

A potentially troublesome problem is that a part of the Amite River basin lies in the State of Mississippi. Whether an interstate dispute will arise is speculative, and present use levels of this water source do not suggest that a dispute will arise soon.

Since the design for the proposed legislation is not yet evolved, it is difficult to give greater details, but this outline of the problem and the functional plans for solution suggest the existence of substantial legal and political problems. This phenomenon of saline water encroachment is common in many coastal areas. The Salinas River basin, the Oxnard plain, Ventura, Los Angeles, and Orange County in California have experienced this difficulty. On the Gulf coast Miami, Florida, Mobile, Alabama, and Lake Charles, Louisiana are experiencing the problem. Our research team is hoping that the model which we are designing will be helpful to other communities.

Conclusion

In the field of mineral development, it appears that the principle problems are in determining the adequacy of present leasing institutions for meeting new types and techniques of mineral development, the complex regulatory system, and the relationship of the extractive industries to competing users of the coastal margin. Water resource problems center around protection of surface sources from pollution, preservation and replenishment of ground water supplies, and planning to assure that water is made available in adequate quantity and quality to those areas which are or may become shortage areas. A related problem is the prevention of subsidence caused by lowering of water levels.

LEGAL ASPECTS OF REAL-ESTATE DEVELOPMENT OF THE COASTAL MARGIN

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It is impossible to fully explain all the potential problems of a real-estate developer on the coastal margin. Therefore, this chapter will be an overview of the present law and the problems which must be resolved to facilitate development.

When dealing with title considerations on the coastal margin, the coastal margin is defined as that area along the coast adjacent to bodies of water which are affected by the daily ebb and flow of the tide. If the body of water is not perceptibly affected, then the legal principles involved are those relating to lakes and rivers.[1]

Initially, the developer and his attorney need to determine two things: the date the land was granted by the sovereign; and whether the call in the deed is for a tidal body of water as a natural boundary.

Early Boundary Decisions

There are many early Texas decisions in which the question of the delineation of the boundaries of tidal properties was discussed.[2] All early discussions, however, were unnecessary to the decisions of the cases and were, therefore, rejected as dicta by the Supreme Court of Texas in the leading case in this area, *Luttes vs. State*, 324 S.W.2d 167 (Texas 1956). However, the early cases probably did influence the court in *Luttes* to maintain that there was a difference between the common-law boundary of tidal grants and the tidal grant boundary of civil law jurisdictions.

The leading case in the United States on the common-law boundary of tidal grants is *Borax Consolidated vs. City of Los Angeles*, 296 U.S. 10, 56 S. Ct. 23 (1935). In that case the city was claiming title to an island under a grant from the State of California. The defendant claimed title by virtue of a federal preemption certificate. The determination of this issue required a decision on the boundary line between upland and tidelands. Since a federal grant was in issue, the court treated the matter as one of federal law and found that for common-law grants the tidal boundary was that of mean high-tide, relying on English common law, and stated that this was the same line the U.S. Coast and Geodetic Survey defined as mean high-water. The court rejected the contention of the United States that only the neap tides should be considered and held that the average should be taken as near as possible on the basis of the 18.5-year tidal epoch.

Although this decision was one involving federal law, the *Borax* decision has been very persuasive in determinations by state courts regarding the correct interpretation of the common law and the method of establishing the tidal datum to be used. More important in Texas, dicta in *Borax* suggested that the line between seashore and upland under civil law was different from that established by common law.

For many years, Texas had no authoritative ruling on the question of the boundary under civil-law grants from Spain and/or Mexico. In 1941 the famous case of *State vs. Balli*, 190 S.W.2d 71 (Texas 1941), was decided by the Texas Supreme Court. The land in controversy was Padre Island, granted to Padre Balli by Spain and confirmed by Mexico. Under the provisions of the Treaty of Guadalupe-Hidalgo, Texas was required to recognize its validity, if it was valid under state law. The state hired Mr. J.S. Broyles to survey the tidal boundary of the lands to describe metes and bounds of the land in dispute. For a reason not explained in the opinion or briefs, Mr. Broyles surveyed what was purported to be the line of mean high-tide.

After losing in the trial court, the state on appeal raised the question about the proper boundary and contended that the state's title should be confirmed up to the line of highest tide in winter, basing this contention on *Las Siete Partidas*. The intermediate appellate court and the Texas Supreme Court rejected this contention on the basis that evidence in the case indicated no substantial difference between high-water and mean higher high-water. Apparently many persons interpreted this statement as meaning that *legally* there was no distinction between the common-law and civil-law boundaries. This interpretation was supported by cases in Louisiana and Florida.[3]

Finally, in *Luttes vs. State*, 324 S.W.2d 167 (Texas 1956), the Texas Supreme Court held that grants of tidal lands from Spain or Mexico were bounded on the shore by the line of mean higher high-water and said that the way to prove this line was by using a tide gauge at the property and by correcting that gauge by nineteen-year readings from a primary gauge. The court also stated that common-law grants were bounded by the line of mean high-water.[4]

Thus, under Texas law, boundaries of land titled prior to 1840 are to be located at the line of mean higher high-water while boundaries titled after that date are based on mean high-water. The year of 1840 is the watershed since it was in that year that Texas adopted common law. In computing mean higher high-water, only the higher of the two daily highs are averaged on the 19-year period. Mean high-water, on the other hand, involves an averaging of the two daily highs and averaging these daily-average values over the 19-year period.

After wading through all these legal problems of definition, those of us who have had occasion to see the results of tidal gauges on the Texas coast are somewhat chagrined to find that in many areas there is no difference in result under the two theories because there is only one high and low tide each day. Had scientific data been used earlier, perhaps nearly 100 years would not have been spent in defining the distinction between civil and common law tidal boundaries.

Ascertaining Tidal Boundary

The Texas Supreme Court in *Luttes* held that the most reliable method of determing the tidal level makes use of primary and secondary gauges. The primary gauge is one which has been in existence for at least 19 years. The secondary gauge is one located on or near the property for which the line is being sought. After reading the secondary gauge for one year the reading can then be corrected by using the primary gauge and a level can be arrived at for the full tidal epoch. In its original opinion, the court's language was certainly open to the construction that tidal gauges were the sole method to be used. However, the court opinion on motion for rehearing was that it did not intend to foreclose the use of some other method which science might provide. But it continued to reject the State's contention that it should use a *bluff line* or *vegetation line*.

The court indicated that if it could be proved that the daily wash of the tide was higher or lower than that indicated by tidal gauges, then the previous boundary line would prevail. Because this would require constant observation over a full tidal epoch, I am unable to say that this language is very meaningful. A further objection to personal observation or even other forms of scientific observation would be the inability of the observer to determine when such wash was caused by meteorological, as opposed to tidal, forces. Because of these practical difficulties, attorneys have ignored this language and advised their surveyors to proceed on the basis of tidal gauges.

The *Luttes* decision has been generally approved by attorneys on the basis that the legal profession now has a definite rule for locating the tidal boundary of land titled before 1840. Surveyors indicate, however, that such a method of locating a boundary is one which appears legally certain but is difficult to locate on the ground. Because of

the extreme flatness and the general lack of recognizable topographic features on the bay side of the barrier islands, the land established by a surveyor is likely to be the best approximation obtainable--but still largely an approximation. The only rejoinder which the law can make to this assertion is that the test established appears to be superior to any of the other tests suggested to the court.

The State had suggested three alternatives:

1. The average over a 19-year period of the single highest wave in each year measured not by vertical height but by the point it gains on the shore;

2. The *visible line* method based on what was called a wave-beat shelf, a drift line, or a vegetation line;

3. The line of mean higher high tide plus 20 varas, based on the Spanish Royal Order of 1815.

I believe that each of these alternatives readily demonstrates its weakness from a practical point of view.[5] It suffices to answer the surveyor who complains of the establishment of mean higher high-water based on tidal gauges that their own association had recommended it to the court.[6] Although attorneys, surveyors, and landowners have all complained about the rule, it appears that it is the best rule that could be given at the time.

Gain and Loss of Title

Apart from the fact that tidal boundaries are based on tidal levels, other uncertainties concerning location of a boundary line are caused by the doctrines of accretion, reliction and erosion. *Accretion* is the process by which natural causes increase land by the deposition of solid material, making land dry that was once covered with water.[7] *Reliction* is the process whereby land becomes flat, not by additions to its surface but by the decline or withdrawal of waters.[8] Some courts have confused this term with *erosion* which is the gradual washing away of land by water.

It has long been held in Texas that the owner of a riparian tract of land on rivers and lakes is entitled to the additions to his land resulting from accretion. In *State vs. Balli* this same rule was extended to owners of land on tidal waters. The right of the riparian is not dependent on whether the title originated before or after the adoption by Texas of the common law in 1840. Despite the seemingly concrete nature of this rule, many problems confront the landowner in establishing his right to such additions. *Luttes vs. State* caused additional worries.

Initially, the private landowner must face the problem of having the State of Texas as his neighbor. With few exceptions the State owns the bay bottoms and the bottom of the Gulf. Thus, any litigation over changes of boundary by accretion will generally be with the State or its lessee. The practical effect of this is that the State may sue an adjoining owner and, simply by showing that the area in suit was originally below water, shift the burden to the landowner to prove accretion.[9] While this may not sound complex, the task is difficult because certain language in the decision in *Luttes*, if improperly construed, could make the task impossible.

Criteria for Legal Accretion

It is generally stated that *legal accretion* must meet three tests: contiguity of land to water; causation must be natural; and addition must be gradual and imperceptible.

The test of contiguity is merely another way of stating that for a landowner to be entitled to accretion, the body of water must be a natural boundary of the upland tract.[10] Thus, where a public roadway or other barrier exists between the owner's tract and the body of tidal water, accretions do not inure to the benefit of the upland owner.[11]

The test of naturalness of causation has spawned many problems. In its original opinion in *Luttes*, the Texas Supreme Court indicated that *legal* accretion--that to which the upland owner is entitled--is only that caused by *purely natural* processes. It pointed out that the trial court had found that much of the accretion in issue was due to activities of man, such as caused by cutting the intracoastal canal. On motion for rehearing, the court withdrew this language and said that this question was still open in Texas.

This *almost* ruling by the court must cause any landowner, or his attorney, to pause since eight members of the court were willing to agree to this original statement. It would appear that the original language of the court is not sound from either a scientific or legal viewpoint. In the first place, there have been so many human modifications of the coastal margin that any landowner attempting to prove accretion by "purely natural causes" is bound to fail.

The intracoastal waterway extends the length of Texas from Sabine Pass to Brownsville. The passes cutting through the barrier islands have, in some instances, lowered the water level in the bays behind the barrier islands. There have also been numerous deep-water ports created. These are only the most obvious and direct man-made alterations on the margin. In addition, huge dams have been built in all of the river systems, thus cutting down the amounts of water and soil being brought to the Gulf. Agricultural activities such as irrigation have also resulted in changes throughout the coastal margin. These

processes have been going on since man first began to alter the environment. Changes in the various upper inland watersheds have undoubtedly had a material effect on the environment, including the coastal margin.

From a legal point of view, the requirement of purely natural causation is disastrous and unfair. First, it is impossible for a landowner to show that any of these man-made alterations have no effect--clearly they do. So, for all practical purposes, this requirement could end the rule that the upland owner is entitled to accretions.

In addition, many of these projects altering the environment have been carried out by governmental units without the consent, and often over the opposition, of the private landowner. To allow a third person to alter the property rights of another by destroying his right to remain riparian is, in my opinion, unthinkable.

Third, had Texas adopted the rule announced, it would have plainly become a minority jurisdiction. The rule in the overwhelming number of jurisdictions is that the upland owner is entitled to all accretions regardless of causation, so long as it is not the result of deliberate action by the landowner and so long as it is not the result of artificial fill.[12] By withdrawing this portion of its opinion, the court avoided a disastrous mistake and left the question of causation open for enlightened treatment in subsequent cases.

While naturalness of causation is not the test in other jurisdictions, it is well established that a landowner does not acquire the right to additions which result from artificial filling of submerged areas or which result from structures built for trapping sediment. This rule is modified in some jurisdictions when the filling or erection of entrapments is done pursuant to statutory authority. In jurisdictions with statutory procedures for artificial filling or the building of groins, etc., the rule allows the owner to claim title to the land so created. However, such statutes seem to afford little protection to the landowner of the adjoining property.

If a groin or jetty is built by one landowner to trap sediment, his neighbor is likely to lose land on the opposite side of the groin. The groin stops the natural deposition of material by the sea while the neighbor's beach is still subject to the erosive assaults of the tides. Thus, it would appear that more expert assistance is needed in drafting legislation which allows sediment entrapment without harming the property of the adjoining owners.

The third criterion in Texas for accretion is that the process must be slow and "imperceptible." These words cannot be taken in their literal sense. The courts of Texas have construed the "imperceptibility" requirement to mean that while the results may be discernible the process is not.[13] Thus, while periodic examinations of

the shoreline may reveal that additions are in fact being made, an observer cannot watch the growth occur. It appears to me that the thrust of this test is misplaced. No such requirement is placed on loss of title by erosion. Thus, a witness testified that he stood on the bank and watched large quantities of soil fall into the river and yet the court held that title was lost.[14]

The true test of whether accretion and gain of title or erosion and loss of title has occurred should be whether the material added or lost has lost its identity as an identifiable piece of land. Such a test would protect an owner in the case of changes by avulsion which do not result in a loss of title. In the event of avulsion caused by changes in a river course, there is still identifiable real property, although its location may be on the opposite side of the watercourse after a change in stream position. However, whether perceptible or not, if the earth has been placed in solution in the water and has lost its identity as soil, a change in title should be effected.

Apportioning Accretion

Another problem which was left open in *Luttes* was the method of apportioning accretion. The trial court was faced with a problem where there had undoubtedly been accretion to the upland owner's tract and also to a State-owned island. The trial court did not attempt an apportionment between the two in spite of a scientific basis for establishing the line of joinder. This was largely due to its impression that all the accretion was not due to "purely natural" forces.

The Texas Supreme Court, while avoiding the causation problem, sustained the trial court's failure to apportion by avoiding the question. Courts in other States have also had great difficulty with apportionment. Some have adopted a rule that the upland owners are entitled to the same percentage of waterfront property in the accreted areas as designated in their origional grants. Others have left it largely to the judge's discretion. There is very little law or informative discussion of this problem in the cases and commentaries.

Luttes vs. State pointed to three factors as being critical in deciding ownership of accretion: source of material; causation; and point of beginning. (The second factor has already been discussed.) The court failed to point out why source of the material is important. The only other case in any jurisdicion discussing this factor is a subsequent Texas case, *Giles vs. Basore*[15]. Source should be unimportant so long as the material was brought by natural forces such as wind, water, etc. This requirement is irrelevant and should be dispensed with.

The court also discussed the point of beginning of the accretion. It indicated that if accretion began from the bottom of the bay that the resulting upland accretion would not belong to the riparian owner. This statement indicates the court's lack of sophistication since it is clear that the silt deposition which results in accreted land becoming fast land must start from the bottom up.

In fairness to the court, it should be pointed out that the specific problem facing the court included accretion to an island--fast land belonging to the State--and accretion to fast land on the mainland owned by private parties. In addition, the court indicated that in speaking of point of beginning it meant that when the buildup began on the bay bottom and became fast land before joining with the mainland that it would belong to the State because of its ownership of the bay bottom. If the process starts at an island or creates an island or a high point in the sea bottom and from there moves toward the older upland or mainland, becoming fast land as it goes, this new fast land is undoubtedly the property of the State.[16]

While this interpretation is not as naive as the other one, it too causes problems. If fast land arises only a few feet from the mainland, the resulting accretion should still belong to the upland owner to keep his tract riparian and also to compensate for his loss due to erosion.[17]

Problems Caused by Dredging and Filling

A very popular subdivision method on tidal waters involves dredging canals to maximize the number of waterfront lots. While I have been unable to find a case directly in point, a related case (*Janes* case) indicates that where a riparian owner on a river excavates for gravel and the river breaks through into the excavated area, it becomes part of the river and is owned by the State.[18] This result is based on the right of the State to have the natural banks and course of the river preserved. Whether the State has these same rights in bays is not answered. However, the logic would apply and in other situations the courts have resorted to river cases in adjudicating rights in bays and estuaries.

In the particular case involved the decision may be sound; however, it should be pointed out that if Texas follows other jurisdictions and holds that the riparian cannot gain title by artificial filling, then he should not lose title by artificial channeling. The *Janes* case was reversed on other grounds by the Texas Supreme Court, but this portion of the civil appeals opinion received approval. Such a ruling certainly must cause a developer some pause.

Even if the developer is willing to proceed with canals, he must seek permits from the State and from the Corps of Engineers.[19] While his failure to do so may not ever be raised by either, a lending institution may well require that this work be in accordance with all statutes and regulations. In the event of a workable plan for disposing of the spoil, and if no oyster beds are present, obtaining these permits should raise no serious question.

One Texas statute provides for the dredging and filling of submerged lands.[20] The Submerged Lands Act provides that upon application to the county commissioners court a bulkhead line may be established as much as 1,000 feet from the line of mean higher high-water out into submerged lands for "industrial purposes". If this line is approved by the State Board, the landowner may lease this land from the State. Ownership of all minerals is reserved for the State. Only the littoral owner may so lease from the State and provision is made for protecting the adjoining riparian. The statute does not provide for the length of the lease or renewal rights.

These problems immediately appear for the upland owner:

1. Once a bulkhead line is established, any accretion outside that line caused by the bulkhead structures is accretion to State-owned land. Thus, unless the bulkhead line is dredged at frequent intervals, the littoral owner may be depriving his land of its riparian rights.

2. No remedy is provided the upland owner when his original lease expires. Thus, the State may refuse to renew his lease and thus become the owner of improved lands which completely block his access to the water.

3. Is beach development considered under "industrial purposes"? While this statute has a salutary purpose, its full effect should be carefully studied by any owner invoking its provision.

Public Rights in Beaches

It would seem under both the common law and the law of Spain that the area between mean low-water and mean high or mean higher high-water, as the case may be, is *res communes* and that the riparian owner may not exclude the public from this portion of the shores.[21]

In 1959, the Texas legislature passed the Open Beach Law.[22] This is an attempt to establish public rights in and to the area between mean low-water and mean high-water and also to establish an easement in the public area up to the vegetation line. However, if there is no clearly discernible vegetation line or if it begins more than 200 feet

from the mean low water line, then the easement only extends 200 feet from the mean low-water. This statute applies only to beaches on the Gulf side of an island or tract. Thus, along the Texas coast its application seems limited largely to barrier islands. However, two islands are excluded since they have no present access to the mainland.

The controversial parts of the statute from the developer's standpoint are extending the public's right to the vegetation line, and certain presumptions created in favor of the state. Under Section 2, once the attorney general shows that the land in question is between mean low-water and the line of vegetation this constitutes *prima facie* evidence that the title of the littoral owner does not allow him to exclude the public from using the area for ingress or egress and that the public has a prescriptive right in the area for ingress or egress. This statute has never been construed by the courts. However, with continued beach development, cases are certain to arise in which the statute will be invoked.

A case in which the statute was discussed, but not construed, arose in Galveston. The statute did not come into play since the Attorney General avoided use of the statutory presumption. There, the court held that the public through long, continued use demonstrated by "proof" had acquired an easement by prescription in the beach.[23]

The statute has been amended, perhaps to mollify owners, to allow the counties control of traffic and litter on the beaches. Under this statute some counties have closed portions of the beach to automobile traffic if other long stretches of beach are available for public use. The statute also seems to provide that nothing in the statute prevents an owner from refusing ingress and egress over his land to reach the "public zone" created by the statute. This requirement is satisfied by existing or future public ways to be provided by the counties. The statute seems to give more than it does in actual practice.

Liability for Pollution of the Shoreline

If a landowner is guilty of discharging materials upon a neighboring littoral owner's land, the case may be handled under existing common law remedies of nuisance and/or trespass. A few new problems are present. However, with the breaking up of the huge oil tanker off the English coast and the subsequent spoilage of much of the English and French beach resort area, a developer may well inquire as to his right to seek relief for damages caused by pollution by vessels.

If by discharging waste or oil offshore a vessel injures a developer's beach, suit may be brought in the United States District Court as a part of its admiralty jurisdiction.[24] This statute was utilized in New Jersey when barges transporting oil broke up and discharged their oil upon neighboring beaches.[25] Once jurisdiction has been gained, the owner again may resort to traditional principles of trespass and nuisance.

Statutory enactments may aid the developer in his action. Two Federal acts presently forbid vessels to discharge refuse and oil.[26] These are statutes with criminal sanctions and are enforced by the Federal government. Thus, the developer's problem of locating proof of responsibility may be lessened by federal agencies. In addition, if violation of the statute is established by the Federal government, then the developer may be able to claim negligence as a matter of law arising from willful tort or the violation of a criminal statute.

One problem exists when a large oil slick appears off the coast. If a landowner takes action to prevent the damage and is successful, he may be unable to recover his costs since a completed tort was never effected because no damage to his beach actually occurred.

Building Restrictions

Because of the possibility of violent storms even greater reasons exist for the adoption of building codes on the coast. Florida has such a code requiring that buildings meet certain design specifications with storm forces in mind. In Texas no such code exists. In fact, only on Padre Island in Wallacy and Cameron Counties[27] and in areas within a city or within five miles of a home-rule city is there any control by governmental authorities on the type of buildings erected. Immediate action is required to establish controls on building and subdividing all along the Texas coast.

Many developers who understand the need for quality and strict building regulations have imposed controls through the use of restrictive covenants with certain standards of construction. While these restrictions are effective, too often they are drawn in such a manner as to impede the use of new, but sound, building techniques and they *freeze* progress in construction improvements. In addition, such restrictions do not provide flexibility because every owner has the right to enforce them. Thus, without unanimous agreement and the attendant expense, a covenant cannot be changed. Although such covenants offer some immediate control, they are not long-range solutions. In addition, it should be remembered that some developers may well sacrifice quality to make their development salable in a shorter period of time to a larger market. This usually results in using septic tanks and other undesirable building features.

References

1 *Humble Oil & Refining Co. vs. Sun Oil Co.* 190 F2d 191 (5th Cir. 1951). See also *Luttes vs. State*, 324 S.W.2d 167 (Texas 1956)

2 See Kenneth Roberts, *"The Luttes Case--Locating the Boundary of the Seashore," Baylor Law Review*, 12 (1960), 141; William Gardner, Jr., "The Shoreline for Spanish and Mexican Grants in Texas," *Texas Law Review*, 38 (1960), 523; T.M. Diamond, "The Effects of Common and Civil Law on Tidal Boundaries," *Baylor Law Review*, 9 (1957), 40; E. Richard Criss, Jr., "Note," *Texas Law Review*, 37 (1958), 249.

3 See *Apalachicola Land & Development Co. vs. McRae*, 86 Florida 393, 98 So. 505 (1923); *New Orleans Land Co. vs. Board of Levee Comm'rs*, 171 La. 718, 132 So. 121 (1931).

4 See *Giles vs. Basore*, 154 Tex. 366, 278 S.W.2d 830 (Texas 1955).

5 See critical discussion of three proposed methods in Roberts, supra note 2 at 165.

6 See quotation from Texas Surveyors' Association in Roberts, supra note 2 at 167.

7 *Denny vs. Cotton*, 22 S.W. 122 (Tex. Civ. App. 1893, error refused).

8 *Ibid.*

9 *Luttes vs. State*, 324 S.W.2d 167 (Texas 1956).

10 *State vs. Arnim*, 173 S.W. 2d 503 (Tex. Civ. App.- San Antonio, 1943).

11 *Gibson vs. Carroll*, 180 S.W. 630 (Tex. Civ. App.- San Antonio, 1915) dedicated roadway between developer's land and water cut off owner's right to accretion.

12 See Roberts, supra note 2, at 169; Annot. 91 A.L.R.2d 857.

13 *Denny vs. Cotton*, supra note 7.

14 *Oklahoma vs. Texas*, 260 U.S. 606, 43 S.Ct. 221 (1922).

15 *Giles vs. Basore*, supra note 4.

16 *Ibid.*, 189.

17 Roberts, supra note 2, at 171.

18 *State vs. Janes Gravel Co.*, 175 S.W. 2d 739, reversed on other grounds. 180 S.W. 2d 144.

19 33 U.S.C.A. 403; Art. 4053(d), Vernon's Annotated Civil Statutes.

20 Art. 5415e, Vernon's Annotated Civil Statutes.

21 *Luttes vs. State*, supra note 9.

22 Art. 5415, Vernon's Annotated Civil Statutes.

23 *Seaway Co. vs. Attorney General*, 375 S.W.2d 923 (Texas Civil Appeals 1964, refused N.R.E.).

24 46 U.S.C.A., 740.

25 *Petition of New Jersey Barging Corporation*, 168 F. Supp. 925 (D.C.N.Y. 1958).

26 *Pollution of the Sea by Oil*, 33 U.S.C.A., 1001; Refuse Act, 33 U.S.C.A., 407.

27 Art. 23721, Vernon's Annotated Civil Statutes.

COASTAL NAVIGATION AND ITS ASSOCIATED LEGAL PROBLEMS

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Navigation in the protected and open waters of the coastal margin is inextricably allied to the past, the present, and the future exploration, development, and protection of the coastal margin from the Florida Keys to the Mexican border.

Since the Congressional Act of March 3, 1873, authorizing the survey for connecting the inland waters along the margin of the Gulf of Mexico from Donaldsonville, Louisiana, to the Rio Grande River in Texas, the acts of the United States and the Gulf States to provide inland waterways and protect navigation--both inland and in the territorial waters--and to provide for the exploration and development of their natural resources have been subject to a mass of Federal and State laws and regulations. These laws and regulations have provided orderly procedures and guides for the vast activities of the coastal region, many of which require the attention of diverse technical professions.

Laws Associated with Coastal Margin Navigation

The laws and regulations associated with navigation on the coastal margin are legion. They include navigation regulations for the streams emptying into the Gulf of Mexico, general rules for inland waters, international rules for the high seas, anchorage, bridge, danger-zone, dumping-ground, fishing, hunting, and oil-pollution regulations, fairways through oil and gas fields, permits for installation of industrial facilities in or adjacent to navigable waters, removal of wrecks, and dredging.

These laws and regulations are administered by many state and federal agencies, including the Corps of Engineers, United States Coast Guard, United States Fish and Wildlife Commission, Department of the Interior, Federal Water Pollution Control Administration, Department of Transportation, Louisiana Department of Public Works, Louisiana Wildlife and Fisheries Commission, Louisiana Stream Control Commission, State Lands, and Police Juries. Most of these laws and regulations on navigation had their genesis in the 1888-1899, 1905-1917, and 1924 River and Harbor Acts and need extensive revision and updating, particularly with respect to offshore navigation. For example, the provision regarding wreck removal should be revised to specify removal from the offshore areas, inland waters, and international waters in which oil and gas exploration is authorized.

Laws Associated with Exploration and Development of the Coastal Margin

Before the development of offshore technology and deep-water equipment, the developer of the natural resources in the land-marsh sector was concerned with State laws and regulations applicable to mining, fishing, wildlife habitat, harvesting timber resources, and the Federal-State regulation applicable to the installation of industrial facilities in or adjacent to navigable waters. With the recent rapid advance into the offshore sectors, there are additional Federal-State laws as well as international laws to be observed. Operations on the continental slope beyond the territorial waters need further Federal-State laws and regulations to establish jurisdiction limits and boundaries.

Problems in Louisiana's Coastal Area

In Louisiana, we face many legal problems associated with coastal navigation. Although they are localized, the same types of problems are experienced time and time again throughout the Gulf coast region. Therefore, I offer the following examples as a starting point from which more detailed discussions can take place.

In an effort to provide some sense of order to the wide variety of problems, I have arranged them into two general categories. The first category encompasses the almost infinite variety of legal problems associated with the development and maintenance of the waterway itself. The second category includes the problems associated with the use of the waterway and other related problems.

Problems Associated with Development and Maintenance

With respect to the first category--problems associated with the development and maintenance of the waterway--the straightening of channels has caused us some anxious moments. To facilitate the movement of com-

merce on our waterways, we have straightened many of our meandering rivers and bayous. In the process, not only has the velocity of the rivers been changed but also their flow patterns. In many instances this has caused flooding and erosion of adjacent lands and has created some ticklish legal problems.

Many damage suits have also resulted from the development of new navigation channels. Recently a plan was completed for a navigation channel through Barataria Bay to the Gulf of Mexico. Before the channel was constructed, oyster leases had to be purchased from private citizens who were granted leases from the State of Louisiana. This, in itself, is somewhat of a paradox. However, the worst was still to come. Once the leases were obtained, channel construction began. The economics of the situation dictated that the spoil had to be placed on each side of the channel in an open bay, and sufficient bottom land was secured for this purpose. However, this approach came back to haunt us. Now there are two suits totalling more than $500,000 in which the plaintiffs claim that erosion of the spoil banks and silt deposits from the excavation has destroyed acres and acres of oyster beds. If this situation continues to increase, it will soon be impossible, or at least economically unfeasible, to cut navigation channels in the bays and estuaries of the coastal margin.

Subsea Pipelines

There has been a great deal of litigation concerning the relocation of utilities, especially pipelines, with channel widening and deepening. The crux of the problem is whether or not the pipeline companies should be totally responsible for relocating their facilities when they are in conflict with channel improvements. Since the State owns the beds of navigable streams in Louisiana, companies must bear the expense of any adjustments within the channel right-of-way. But, pipeline companies are not receptive to this practice. There is also some question as to who should bear the expense for adjustments outside of the right-of-way.

Pipeline companies' position is that any costs incurred for adjusting their facilities outside of the right-of-way should be borne by the State or Federal government. They also desire reimbursement for alterations to these installations when a channel is widened or deepened. The state, in turn, holds that the companies should bear all costs.

The navigation project on the Mississippi River below Baton Rouge provides for a navigation depth of 40 feet. Recent proposals indicate that a 50-foot navigation depth will soon be a reality. A company with a permit for pipeline installations to cross the river agrees that all pipeline installations have a minimum 25-foot water depth cover. While the industries are accepting this requirement, they are also asking the question, Who should bear the cost for this requirement? Another question: Must the navigation project always demand priority in such considerations, or will they be reduced to a more reasonable participation from the industrial viewpoint?

A permit must have the approval of at least seven Federal agencies and, in Louisiana, five State agencies. It is not unusual that two months is required for a permit to receive final clearance. Such delays and added requirements are an expensive burden on industry. Can this problem be resolved without major legal implications? Although these problems concern the administration and regulation for the use of waterways rather than legal aspects, they are important and should be considered along with future problems of navigation.

Bank slides caused by dredging have also plagued Louisiana. Due to the shortage of developable land in the coastal area of Louisiana, most development takes place on the adjacent natural high ground created by streams. As you know, this land is quite unstable. Often the least disturbance, such as dredging, can cause considerable sloughing and sliding along the channel banks, which can instigate damage claims. A case in point occurred some 40 miles southwest of New Orleans. Suction dredges were being used to maintain a navigation channel in Bayou Lafourche. This dredging apparently disturbed the stability of the area and caused a bank slide in which two residential dwellings were completely destroyed. Although damage claims were comparatively small, one cannot help but wonder what they would have been if human lives had been lost.

Another situation open to question regards the increased cutting of secondary navigation channels in the coastal marshes of Louisiana. The majority of these channels are being developed by private companies to obtain access to and from isolated areas. As yet, the ramifications of these channels on the environment are not known. It is known, however, that man's activities have seriously affected the delicate balance which exists in nature. For example, what if this secondary channel activity destroyed major coastal industries such as the fur or fishing industries? If this should occur, who would be responsible?

The restoring of access to land severed by navigation channels is also a problem in coastal areas. Because of the hydrology and topography of the region, many times there is frequently only one land route. If this route is severed, who is responsible for reestablishing the access?

Then there is the ever present problem of saltwater intrusion. Whenever navigation channels are cut from the Gulf of Mexico inland, we run the risk of contaminating freshwater supplies. This contamination could ultimately destroy the environment upon which the coastal economy is built. From another angle, channel deepening for navigation can introduce more freshwater and change the value of the adjacent marshes. What are the legal implications of such manipulation of the water resources and the resulting influence upon adjacent land holdings?

Problems Associated with Use

In addition to the problems associated with the development and maintenance of waterways, there are numerous legal problems connected with their use. Probably the most common of these is bank erosion caused by waves from boats and barges. Although precautions are taken to minimize this type of damage, there are many damage claims each year.

Though the problem is usually not considered to be crucial, it takes on added significance when one considers that the State of Louisiana owns the river beds of navigational streams. Take, for example, the situation where wave action through the years continues to erode private property. Basically what is happening is the State is gaining new holdings at the expense of private property owners. When mineral rights are involved, a few feet can mean a few million dollars.

A similar problem is bank erosion caused by water craft. In the last few years there have been several lawsuits filed when private property was gouged out by wave wash from barges and boats.

Marine collisions with bridges have also been a problem in Louisiana. An example is the causeway across Lake Pontchartrain just outside New Orleans. The structure is 24 miles long and has three raised *humps* for marine traffic. It is constructed primarily of precast concrete sections supported on pilings extending 20 feet above the lake.

Since its opening in 1956, it has been rammed 11 times. Six of the eleven collisions resulted in the collapse of two or more 50-foot sections into the lake. Damages to the bridge alone have already exceeded $1.5 million.

The worst marine collision to date caused the death of six people when a Continental Trailways bus went into the lake. The present fatality rate of the bridge is 6.6 fatalities per one million vehicle miles. The national highway average is 5.7.

Who is responsible for the safety of structures like the Pontchartrain Causeway? Or better yet, who is responsible for the accidents? The boat operators? The engineers who built the Causeway? Or the Commissions who operate the Causeway?

Pollution from vessels is becoming a significant problem which could have enormous legal overtones. The areas of concern include oil wastes from marine engines, sanitary wastes from vessels, and spillage of cargo during loading and unloading operations. All of these problems are particularly germane to Louisiana since the majority of the coastal cities obtain their water supplies from surface sources.

There is also the ever-present danger of structural breaks occurring in vessels, like the oil tanker off the English coast, which would cause unprecedented harm to man and his environment. The incident of the sinking of the chlorine barge in the Mississippi River opposite Baton Rouge had legal ramifications which are still unresolved. The U.S. Army Corps of Engineers raised and salvaged the barge at a cost in excess of $1 million. Is the barge operator or owner liable for this cost? If the chlorine had escaped and killed someone, who would have been legally responsible? As yet, we do not know the legal ramifications of many of these problems. But if and when something does happen, you can be sure it will be serious.

The anchoring of vessels has also come under scrutiny. Many times anchors are dropped indiscriminately with little or no respect to or knowledge of pipelines and cables traversing the river bottoms. If one of these anchors were to rupture a pipeline, serious damage could be done to vessel and crew. Again the question, Who would be responsible?

The practice of stopping motor vehicles at navigation crossings is also becoming an area of concern. Historically, navigation has always had the right-of-way. This, however, is being questioned. And, shortly, we can expect to see litigation in this area, especially if human life is involved.

The job before us is to find a coordinated, comprehensive approach which will provide some answers. The basic question is, Who is responsible legally for the damage claims, or for that matter, the potential claims associated with the above problems? Are the State agencies such as the Louisiana Department of Public Works responsible? One of the many Federal agencies--the Corps of Engineers or the United States Coast Guard? Local governments? Industry? What about levee boards and other special districts?

Once we have defined the areas of responsibility, the solutions to the problems should be apparent.