THE INTRACOASTAL WATERWAY

BEAUMONT TO CORPUS CHRISTI, TEXAS

By

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PREFACE

From early age the writer has been interested in boats and water transportation. In January 1948 he became interested in the Inland Waterways of the United States and in particular the Intracoastal Waterway of the Atlantic and Gulf Coast region. The appearance of many new industries on the Gulf Intracoastal Waterway brought to the attention of the writer the importance inland waterway transportation plays in transporting the many products produced and used by these industries; the new improvements of equipment for more efficient service; how the waterway affects the daily life of the people of this region and thus it appeared to be a desirable project to analyze. This study was suggested by Dr. David C. Winslow, of the Oklahoma Agricultural and Mechanical College, Geography Department, in 1951, as part of a complete study of the Intracoastal Waterway from Brownsville, Texas to Carrabelle, Florida. Material was obtained from periodicals, Government publications, books, correspondence and field study.

The writer is indebted to Mr. John W. Fullbright, President of the Intracoastal Canal Association for Louisiana and Texas; to the many industries located near the Gulf Intracoastal Waterway, for their cooperation and response to the questionnaire the writer sent out; to the Chamber of

Commerce offices located in the cities on this Waterway; and to the U.S. Army, Corps of Engineers, District Office, Galveston, Texas, for valuable primary source material.

The writer wishes to express his sincere thanks to Professor George S. Corfield, Geography Department, Oklahoma Agricultural and Mechanical College, for his valuable suggestions and supervision and patience in the preparation of this thesis. The writer also wishes to thank Dr. Edward Keso, Head of the Department of Geography and other Geography Faculty members for their suggestions.

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CHAPTER I

EARLY HISTORY OF THE GULF INTRACOASTAL WATERWAY

The oldest known form of transportation is water transportation. An essential means of transportation for the United States ever since its founding has been by inland waterway. During the Revolution, the commerce between the eastern seaboard and New Orleans, on the one hand, and inland communities on the other, was largely dependent upon the use of the inland waterway routes. After the Revolution, the westward migration was confined closely to the inland waterways which then furnished the only practicable means of transportation. As trade with these sections developed it moved principally on waterways.

Built on these inland waterways were many of our largest and most important cities. These cities owe their growth and progress to the transportation available on the waterways. Some of these industrial centers and cities--Pittsburgh, Philadelphia, Minneapolis, Nashville, Mobile, New York City, Baltimore, Jacksonville and San Francisco--were founded by men who were fully aware that water transportation was a prime requisite to their development. This judgment has been proven to be sound through the years.

Inland waterways and inland waterway transportation cannot be taken lightly. The industrial development resulting from the inland waterways has enhanced the progress and welfare of our country and its

position among the nations of the world. One of the last to develop was the Intracoastal Waterway of the Gulf Coast of the United States.

First Conception--Reasons for Construction

In June, 1949, the last link in Texas of the Intracoastal Waterway was completed linking Brownsville, Texas to New Orleans, St. Louis, Chicago, New York and Carabelle, Florida. A continuous waterway between these points was thus established. It afforded a protected coastal waterway route along the Atlantic and Gulf Coast of the United States whereby commercial tows and other light-draft vessels not suited to navigating long stretches of the open Atlantic Ocean and Gulf of Mexico may safely move between Massachusetts and the Mexican Border. "There is a complete waterway connecting the main natural coastal waterways except for a few gaps from Boston, Massachusetts, to the Florida Keys and along the Gulf Coast from Carrabelle, Florida, to Brownsville, Texas."[1]

The Gulf of Mexico, noted for sudden and severe storms, presents serious problems to the navigator. Small craft, even a short distance from shore, find escape difficult. Consequently, the many bays and sounds that indent or parallel the Nation's Gulf Coast provide, wherever possible, a protected passage since the days of the first settlers. Moreover, other modes of transportation along the coast were slow to develop, owing to the marshy country bordering much of the Gulf Coast, e.g., in many cases these sheltered waters were formerly the only means whereby commerce could be carried on between coastal settlements.[2] It

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[1]Department of the Army, Corps of Engineers, The Intracoastal Waterway. Gulf Section, Part II (Washington: Government Printing Office, 1948), p. 1.

[2]The Intracoastal Waterway. Gulf Section, Part II, op. cit., p. 1.

is for the above reasons that the canal was conceived and dreamed of by many men early in the 19th century.

Beginning and Development of Construction in Texas

The first waterway in the Texas Gulf Coast Area was constructed by private interests from the Brazos River to Oyster Bay from 1851 to 1853. This canal, 6 feet deep by 100 feet wide afforded an inland passage for light-draft boats, and was designated as the Galveston and Brazos Canal, and thus technically came the birth of the Inland Waterways.[3] About 1903 this section was purchased by the government for $30,000 to form a link in the chain of inland waterways.[4]

In 1873, Congress authorized a survey from the Mississippi River to the Rio Grande bordering Mexico, to select a suitable route for an inland waterway connecting the two rivers. A 6 foot by 60 foot channel, using natural lakes and streams as much as possible, was considered. The survey report was unfavorable. Subsequent surveys, however, resulted in Congressional approval of a channel from Galveston to Oyster Bay, Texas.[5]

The first Federal improvement in Texas for an inland waterway was authorized by an act of July 13, 1892, which provided for a channel 3½ feet deep by 200 feet wide, in Galveston Bay to connect with the Galveston and Brazos Canal,[6] but affording traffic only for barges and pleasure boats.

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[3]Department of the Army, Corps of Engineers, The Gulf Intracoastal Waterway. Bulletin, SWNVI 000.7 (Washington: Government Printing Office, 1950), p. 1.

[4]Ibid., p. 3.

[5]The Intracoastal Waterway. Gulf Section, op. cit., p. 1.

[6]Bulletin, SWNVI 000.7, op. cit., p. 3.

In 1905, in the town of Victoria, Texas, Mr. C.S.E. Holland issued a call to fellow townsmen and informed them of an idea he had of a canal project extending from the Mississippi River to Mexico.[7] A survey for a continuous waterway from St. Georges Sound, Florida, to the Rio Grande was authorized in 1909. Based on findings of that survey, the River and Harbor Act of June 25, 1910, authorized, among other features, the improvement of the Middle Ground Channel in Lake Ponchartrain to provide a 7 foot depth; a 5 foot by 40 foot channel from the Mermentau River, Louisiana, to the Sabine River and extension of the 5 foot by 40 foot waterway between Galveston and Oyster Bay to Aransas Pass, Texas. Between 1907 and 1925, several improvements in this area, ranging from 5 feet by 40 feet to 12 feet by 90 feet, were authorized and completed.[8]

By 1934 the waterway had been enlarged to 9 feet by 100 feet between New Orleans and Galveston Bay.[9]

The 9-foot by 100-foot project channel from Galveston Bay to Corpus Christi, Texas, was completed in 1941.[10]

An act of Congress approved July 23, 1943, authorized an enlargement of the Gulf Section of the Intracoastal waterway from the vicinity of Apalachee Bay, Florida, to Corpus Christi, Texas, and its extension to the vicinity of the Mexican border, so as to provide throughout the entire length of the waterway a channel 12 feet deep with a minimum width of 125 feet.[11]

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[7]George Sessions Perry, "Now You Can Sail through Texas," The Saturday Evening Post, July 15, 1950, p. 26.

[8]Bulletin, SWNVI 000.7, op. cit., p. 2.

[9]The Intracoastal Waterway. Gulf Section, op. cit., p. 2.

[10]Bulletin, SWNVI 000.7, op. cit., p. 4.

[11]The Intracoastal Waterway, Part 11, Gulf Section. op. cit., p. 2.

The existing project, as adopted by the River and Harbor Act of March 3, 1925, and modified by subsequent acts up to and including the River and Harbor Act of May 17, 1950, authorized, among other features, the enlargement of the Gulf Section of the Intracoastal waterway to provide throughout the entire length of the waterway a main channel 12 feet deep with a minimum width of 125 feet. Except for certain cut-offs, this was completed in June, 1949. The existing project also provides for construction of flood gates or locks at the Brazos and Colorado River crossings at the main channel (Colorado River Locks near Freeport).[12] The Brazos River floodgates, near Freeport, Texas, were completed and placed in operation on August 2, 1943, while those at the Colorado River crossing, near Matagorda, Texas, were completed and placed in operation on August 7, 1944.[13]

The writer, during his field trip to this area in 1951, was able to see these locks in operation and was granted an interview with the man in charge of them. This particular area requires more maintenance than almost any other point of the canal, due to the heavy silt load carried into the channel by these two rivers. An unusual part to consider is the depth of the waterway at the point of these locks. Engineers desire a 30 foot depth on the inside of the locks away from the river.

Several tributary channels extend from this main canal to several small towns and ports. They include: Corpus Christi, Palacios, Rockport, Aransas Pass, Port O'Connor, and the vicinity of Port Isabel. These

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[12] Bulletin, SWNVI 000.7, op. cit., pp. 4-5.

[13] Ibid., p. 11.

channels vary in depth and width but the average ranges from 9 feet to 100 feet to 12 feet by 100 feet.[14]

Ownership and Control

Under its power to regulate navigable waters derived from the Commerce Clause of the Constitution, the Congress, for more than a century, in planning for the Nation's waterways, has placed upon the Corps of Engineers of the Army the responsibility of investigating proposed work, carrying out authorized projects, maintaining navigable channels and operating the necessary appurtenances, such as locks and dams. In enacting laws relating to the functions of the Corps of Engineers, the Congress has usually specified the general procedure to be followed, leaving the administration of the many specific and technical details to the judgment of the Corps of Engineers which has been acquired through long years of experience and familiarity with the work and problems involved. Each waterway project for improvement is thoroughly investigated by the Corps as to its soundness and justification as to costs and benefits before being recommended to the Congress for authorization and the necessary appropriation.[15] All inland waterways are under the control of the Federal Government and are maintained by it.

When an improvement of a public waterway provides, in addition to the required benefits to the nation at large, substantial benefits to the immediate locality through which it passes, it is fitting that the local residents, or some governmental body representing them, should cooperate

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[14]Bulletin, SWNIV 000.7, op. cit., p. 5.

[15]Inland Waterway Transportation in America. (Washington: Government Printing Office, 1948), p. 2.

with the Federal Government in substantial measure toward the accomplishment of the work. Such cooperation, when deemed proper, is made a condition of adoption by Congress, of a Federal project for waterway improvements. The condition usually includes the provision that local interest will furnish, free of cost to the United States, all lands needed for right-of-way and for disposal of dredged materials. In some cases construction of terminal facilities, acquirement of existing projects, and even straight cash contributions toward the cost of the work are required.[16]

Canal as Part of the Intracoastal Waterway from Brownsville, Texas to Massachusetts.

Protected coastal inland waterway routes along the Atlnatic and Gulf Coasts of the United States is now offered by the Atlantic Intracoastal Waterway and the Gulf Intracoastal Waterway. Vessels not suitable for operation on the open water of the Ocean and the Gulf operate with a higher degree of safety along these routes. Small craft are able to reach their destinations quickly and with less effort.

A protected waterway for 2,000 miles extends from Annisquam Canal, in Massachusetts, to the Florida Keys, and passes through or near such ports as New York, New York; Philadelphia, Pennsylvania; Wilmington, Delaware; Baltimore, Maryland; Norfolk, Virginia; Wilmington, North Carolina; Charleston, South Carolina; Savannah, Georgia; Jacksonville and Miami, Florida. The canals included in The Atlantic Intracoastal Waterway include the Cape Cod Canal and the Chesapeake and Delaware Canal.

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[16]Bulletin, SWNVI 000.7, op. cit., p. 7.

A distance of 1,116 miles forms the Gulf Intracoastal Waterway from St. Marks River, Florida, to Brownsville, Texas, on the Mexican border. Cities on this waterway include: Panama City, Florida; Mobile, Alabama; Gulfport, Mississippi; New Orleans, Morgan City, and Lake Charles, Louisiana; Orange, Port Arthur, Beaumont, Houston, Galveston, Corpus Christi, and Brownsville, Texas.

As yet, no connecting waterway between the Atlantic Intracoastal Waterway and the Gulf Intracoastal Waterway exists, except the Okeechobee Cross-Florida Waterway whose channel is only 6 feet deep and 80 feet in width. Congress recognized the need for such a connection when, in Public Law 675-77th Congress, approved (July 23, 1942), it authorized the Cross-Florida Barge Canal across northern Florida between the St. Johns and Withlacoochee Rivers with a 12-foot depth. Construction of this project will begin as soon as the necessary funds are appropriated by the Congress.[17] The estimated cost of this proposed canal, with the same depth as the Gulf Intracoastal Waterway (12 feet by 125 feet), approximates $75,000,000.[18] Congress has not yet appropriated this sum. Resistance to this proposed canal comes from many people in southern Florida. One argument expresses the belief it will ruin their tourist trade by cutting off the many pleasure boats which at this point would cross Florida passing from the Atlantic to the Gulf of Mexico or vice versa. Some believe, furthermore, that the canal would affect the ground water supply, but this is a fallacy as the U. S. Engineers would never

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[17] Inland Waterways-Facts and Figures, (Washington: Government Printing Office, 1950), p. 4.

[18] Perry, op. cit., p. 134.

approve such a measure if they thought it would injure water supply reserves for southern Florida cities.

Completion

The industrialists, the businessmen, the politicians, government workers, farmers along the way, and men in everyday life, view the beginning and completion of this undertaking as a magnaminous project. Man has always had a problem of transportation difficulties in this area. He needed a protected coastal waterway, to safeguard him from frequent and sudden storms and to provide refuge from enemy submarines during time of war, as evidenced in World War II. Cognizant of the protection that the natural physical elements gave in this direction, man recognized that he needed only to complete this linkage of bays and sounds to form a complete safe intracoastal waterway.

It is through this medium of transportation, with its various cargoes of lead, zinc, sulphur, cotton, various small commodities, and the largest of them all--petroleum products--that the writer believes the industries of this area will continue to grow and prosper by the added transportation facilities provided by the Intracoastal Canal.

This study considers only the one part, Beaumont to Corpus Christi, Texas, of the Gulf Intracoastal Canal, a distance of 270 miles. (Map, Figure I).

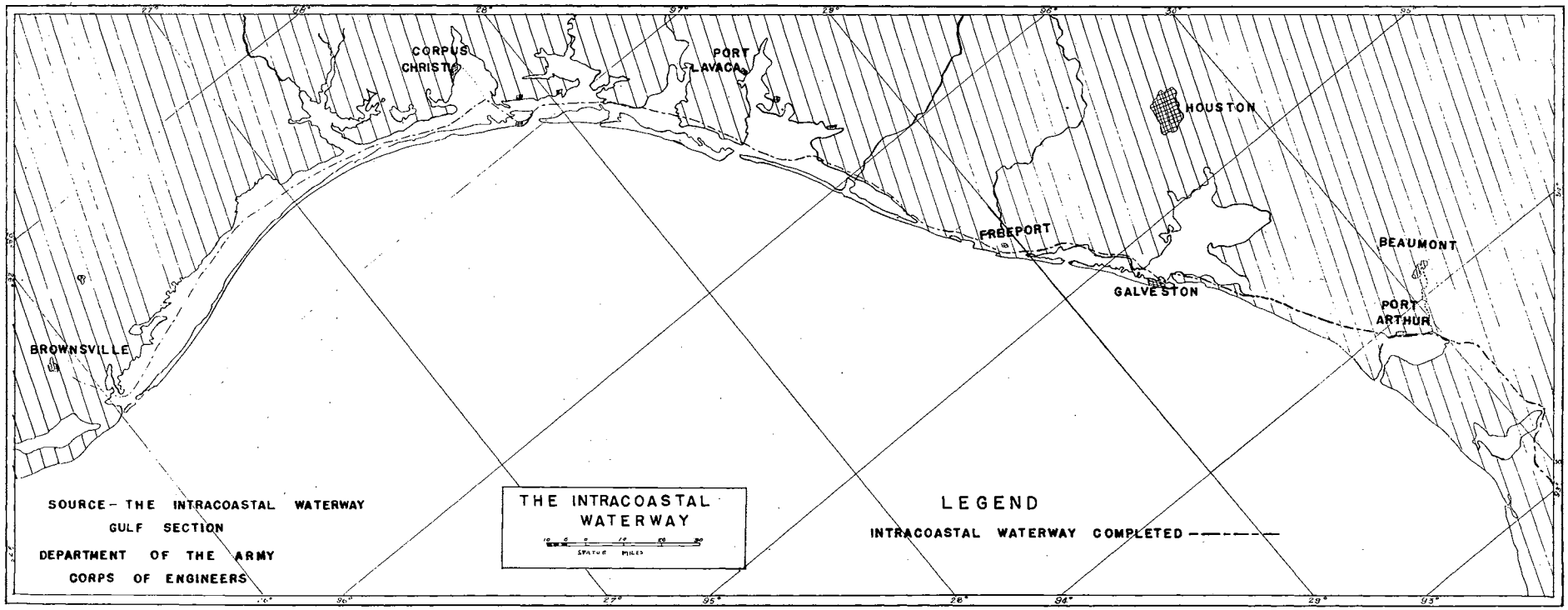
CORPUS CHRISTI
PORT LAVACA
HOUSTON
FREEPORT
GALVESTON
BEAUMONT
PORT ARTHUR
BROWNSVILLE
SOURCE - THE INTRACOASTAL WATERWAY
GULF SECTION
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
THE INTRACOASTAL WATERWAY
STATUTE MILES
LEGEND
INTRACOASTAL WATERWAY COMPLETED

Figure 1

CHAPTER II

CLIMATE OF THE COASTAL PLAIN OF TEXAS

The Intracoastal Canal from Beaumont to Corpus Christi, Texas, is located 30° 5' North Latitude and 94° 7' West Longitude and 27° 50' North Latitude and 97° 15' West Longitude, respectively, running in a Northeast Southwesterly direction.

Classification

According to the Koppen classification of Climates, as modified by R. J. Russel, Texas lies almost wholly in the belt of mesothermal temperatures.[1] As the writer saw several different types of vegetation in this area it is believed this general classification can be broken down and is evidenced by its being given three classifications. The area is divided into three sections: (1) Corpus Christi to Port Lavaca, CS'd, subhumid-mesothermal-precipitation scanty at all seasons, (2) Port Lavaca to Freeport, CS'r, subhumid-mesothermal-precipitation adequate at all seasons, and (3) Freeport to Beaumont, BB'r, humid-mesothermal-precipitation adequate at all seasons.[2]

Precipitation

Severe storms are more numerous in humid East Texas than in other

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[1] Richard J. Russel, "Climates of Texas," Texas Geographic, Autumn, 1943, p. 17.

[2] C. Warren Thornwaite, "Climates of North America According to a New Classification," Geographical Review, 1931, p. 656.

parts of the state for the reason that vast amounts of energy lie latent in atmospheric moisture as witnessed the maximum precipitation in the summer months from the many thunder storms and line squalls.[3]

The summer maximum of precipitation comes in July, August and September due to numerous thunder storms and line squalls. One will find maximum precipitation during the morning because of the cumulus clouds which are built up during the night as the land cools off. Minimum precipitation appears in the winter, fall and spring.[4]

TABLE I

AVERAGE PRECIPITATION[5]

Station	Length of Record	Ann.	Jan.	Feb.	Mar.	Apr.	May
Beaumont	40 yrs.	52.37	3.9	3.7	3.5	4.0	5.2
Port Arthur	26 yrs.	50.66	4.2	3.9	3.2	3.1	4.5
Galveston	40 yrs.	42.36	3.5	3.8	2.5	3.5	3.5
Freeport	18 yrs.	49.93	3.9	2.9	2.8	2.7	2.9
Corpus Christi	40 yrs.	25.22	1.1	1.6	1.6	1.8	3.1

	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Beaumont	4.3	5.4	5.1	4.2	3.6	3.8	5.4
Port Arthur	4.2	6.4	5.1	4.6	3.3	3.2	5.3
Galveston	3.5	4.1	3.8	5.4	4.5	3.3	4.1
Freeport	3.7	4.6	2.8	6.5	3.4	3.9	4.6
Corpus Christi	2.7	1.9	1.5	4.5	2.5	1.8	1.9

The annual precipitation in this entire area is very much the same except Corpus Christi, which had 25.52 inches (annual), compared to 52.37 inches (annual), in Beaumont and the other three stations, Port

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[3]Statement by E. P. Hildreth, personal interview, April 16, 1952.

[4]Russell, op. cit., p. 18.

[5]U. S. Department of Agriculture, Yearbook of Agriculture. Climate and Man, (Washington: Government Printing Office, 1941), p. 1193.

Arthur, Galveston and Freeport having a close correlating precipitation to the Beaumont Station.[6]

Temperature

The coastal counties are characterized by comparatively uniform temperature in all seasons, with a small diurnal range (Figure II). Also, the progress of the season is retarded, winter lingers into spring and summer into fall. This area having a marine climate gives it a comparatively pleasant summer, mild winter, cool spring and a warm autumn. This type of climate is one in which a person feels well except during the humid summers and autumns.

The relative humidity is shown below.

TABLE II

RELATIVE HUMIDITY[7]

Station	Jan.	Feb.	Mar.	Apr.	May	June
Port Arthur	80	64	71	73	73	87
Galveston	85	74	71	82	80	76
Corpus Christi	81	64	73	88	78	75

	July	Aug.	Sept.	Oct.	Nov.	Dec.
Port Arthur	70	77	72	77	76	77
Galveston	72	79	72	81	78	89
Corpus Christi	76	77	68	76	74	81

Note: Recorded at noon--over a 36-year period

Relative humidity between 30-70 per cent is considered very good for health and comfort.[8]

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[6] Ibid., pp. 1130-1139.

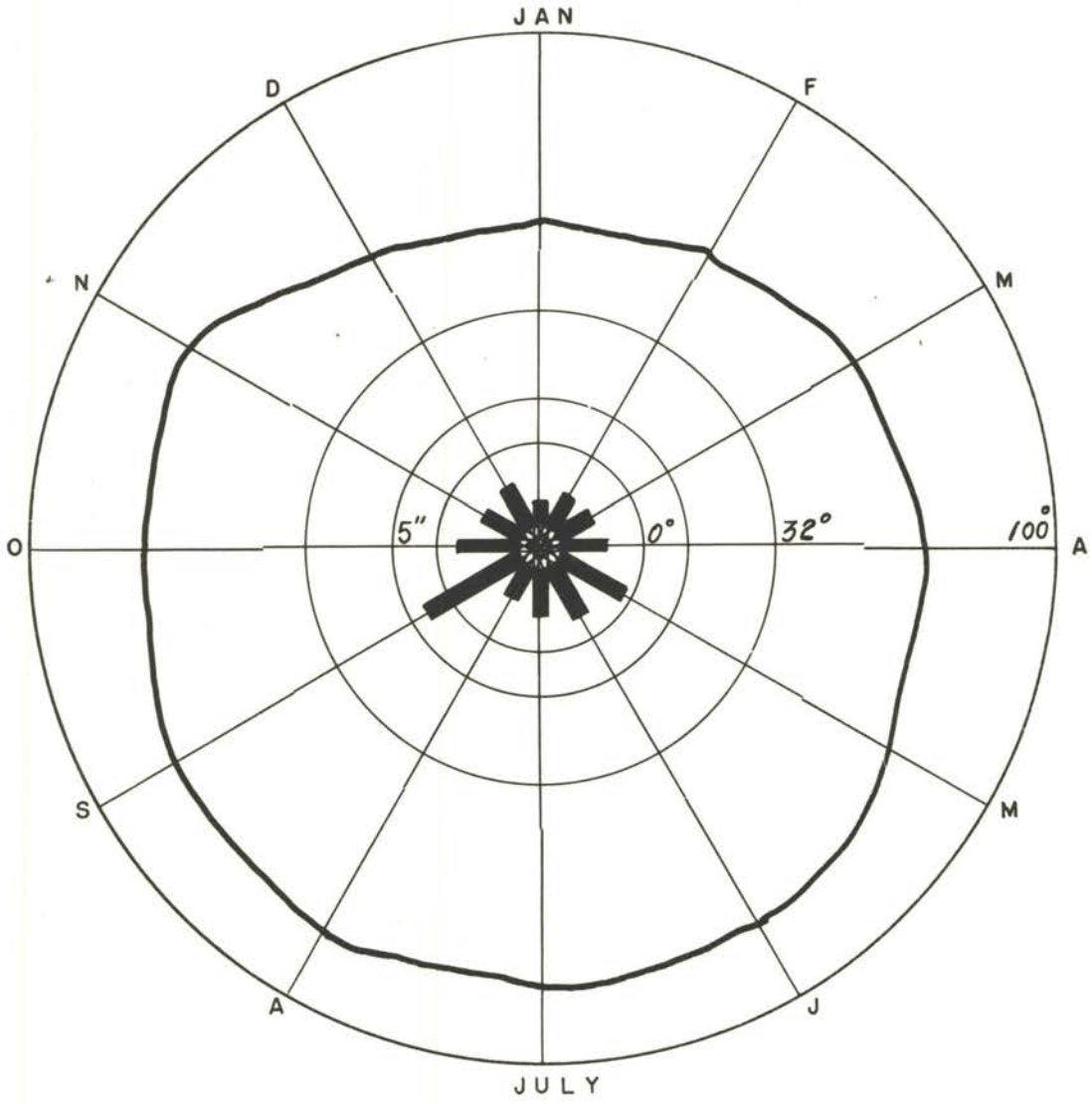
[7] U. S. Department of Commerce, Climatological Data, Texas Section, Vol. LII (Washington: Government Printing Office, 1947), p. 1132.

[8] Climate and Man, op. cit., p. 1130.

CLIMATIC GRAPH

CORPUS CHRISTI, TEXAS

1938 – 1948



	JAN	F	M	A	MAY	J	JL	A	S	O	N	D
TEMPERATURE	54	56	63	69	73	79	82	82	79	71	63	57
PRECIPITATION	1.1	1.6	1.6	1.8	3.1	2.7	1.9	1.5	4.5	2.5	1.8	1.9

Figure 2

The temperature of Corpus Christi given on Figure No. 2 shows a uniform range. The Beaumont Station was chosen to represent the northern area of this study.

The temperature of Corpus Christi is so mild and pleasant to work in that the Corn Products Manufacturing Company has built its plant without permanent walls. They have portable shelters or wind breaks for the workers in case of severe winds or short cold spells.

Frost

No part of Texas is entirely free of damaging frost or freezing weather but this area has seldom experienced any. There are exceptions, however, for example, in February, 1948, a Norther caught thousands of Red fish in the shallow lagoon between Padre Island and the Texas mainland near Corpus Christi and it was so severe that the cold stunned the fish and enabled the sportsmen and fishermen to dip them with small nets.

TABLE III

KILLING FROST AVERAGE DATES[9]

Station	Length of Record	Last in Spring	First in Fall	Growing Season
Beaumont	36 yrs.	Feb. 23	Dec. 6	286 days
Port Arthur	22 yrs.	Jan. 28	Dec. 15	321 days
Galveston	40 yrs.	Jan. 21	Dec. 28	341 days
Freeport	-------	-------	------	--------
Corpus Christi	40 yrs.	Jan. 26	Dec. 27	335 days

Note: Length of growing season between average dates and last killing frost in spring and first in fall.

The average date of the last killing frost (Galveston Island) falls

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[9] Climate and Man, op. cit., pp. 1130-1133.

on January 21 and later as you go north.[10] The first killing frost date in Corpus Christi is December 27. Only in the coastal area of Rio Grande Valley is there such a late killing-frost date.[11]

Vegetation

There is very little vegetation on the two long islands, Mustang and Padre Islands, which are now joined together by the wave action of the Gulf of Mexico. Although these two islands are lacking in more than a moderate amount of vegetation, there is enough grass to support the large herds of cattle found grazing there; otherwise, the Islands have only shrubs and a semi-arid condition exists.

North of Port O'donnor, the northern limit of Matagorda Island, the vegetation on the mainland of the Texas Coastal Plain increases due to increasing amount of precipitation. The area bordering the Texas Gulf Coastal Plain, 20 to 50 miles in width, has much the same vegetation from Corpus Christi to Galveston, Port Arthur and Beaumont, with the latter city having more precipitation and increased vegetation due to its location farther inland.

Wind

The wind is probably the most serious factor that hinders operation on the canal and in the Gulf of Mexico.[12] It has been estimated that 80 per cent of the time waves 4 feet or over, sometimes as high as 7 to 12 feet are caused by wind and are very dangerous to small craft

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[10] Climate and Man, op. cit., p. 1132.

[11] Ibid., p. 1132.

[12] Hildreth, op. cit.

in the Gulf. At the same time, however, though there are no waves to speak of in the canal, the wind plays havoc on the empty or loaded barges as they work their way up and down this Inland Waterway.[13] The writer interviewed a bridge tender who was operating the draw bridge on the Padre Island causeway and was informed that he had witnessed (many times) the dangerous action of the winds affecting barges. Sometimes barges crashed into the piling with such a terrific force that it caused damage to the piling as well as to the barges.

Barges sometimes break loose from the tugs due to the high wind, leaving the channel, where the tugs cannot follow, only to be retrieved by small boats. This condition is present through the shallow lagoon near Padre Island, Espiritu Santo Bay, Matagorda Bay and East and West Bays.

The Island chain, on the leeward side of the Canal, varying in elevation from 7 feet to 20 feet, sometimes acts as a barrier or breaks the wind. This chain of islands is approximately 250 miles south of Freeport, Texas.

The prevailing wind direction, its force and consistency is shown by Figure III.

Fog

One of the climatic disadvantages, for vessels operating on the canal, of less importance than wind, is fog. In the Eastern area of the Intracoastal Waterway in Louisiana, fog is considered a great hazard to navigation. In Louisiana fog is more common because of the larger land area the canal passes through, in contrast to the Texas portion of the

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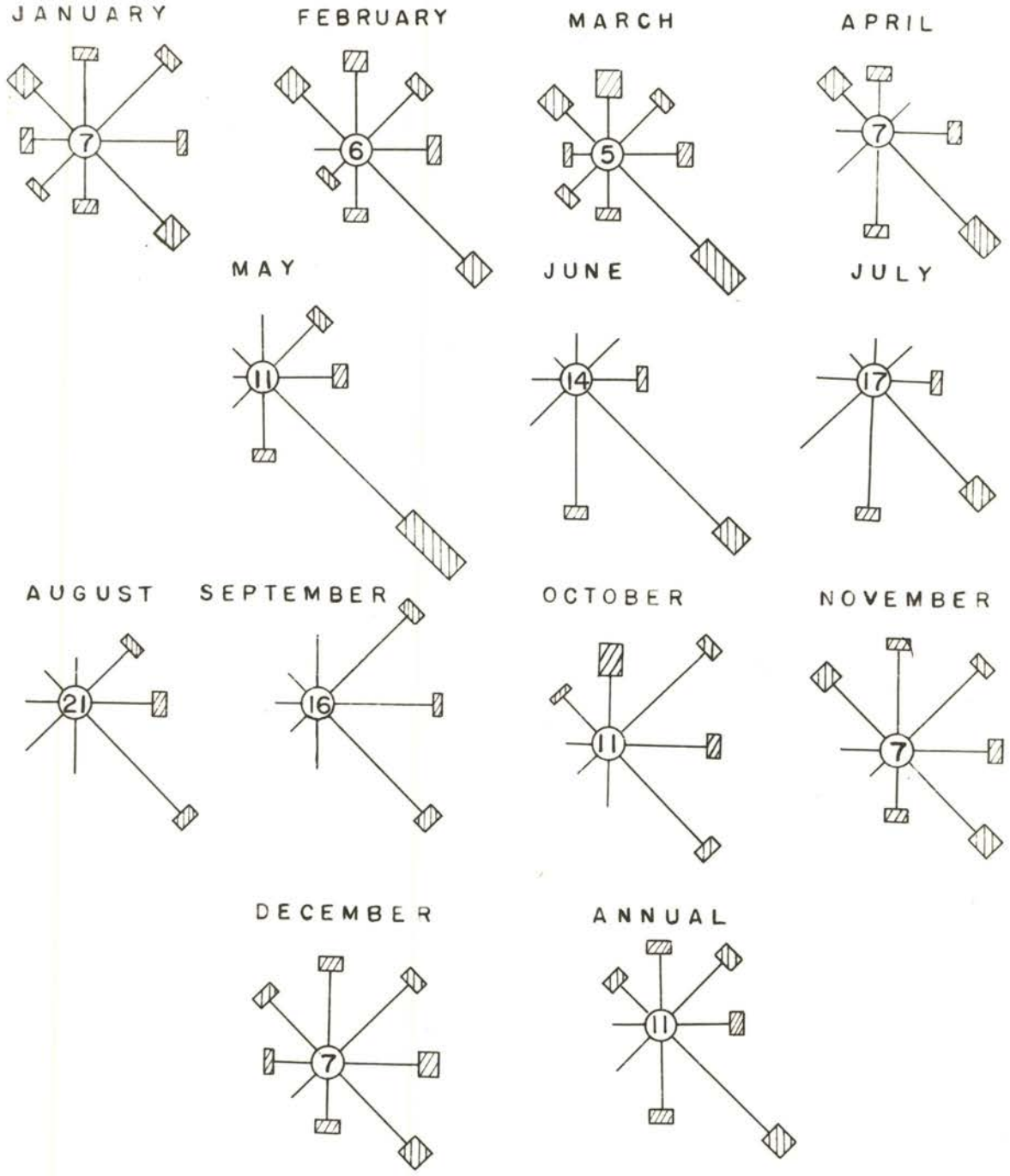
[13] Mildreth, op. cit.

SURFACE WINDS



STATION = HOUSTON, TEXAS

SOURCE = AIRWAY METOROLOGICAL ATLAS FOR THE UNITED STATES

LEGEND

○ % OF CALMS

— 4-15 MILES PER HOUR

▨ 16-31 " " "

TH

Figure 3

canal as it passes through the many bays and therefore this fog is due to Radiation. Along the Texas coast the fog is highest in December, January and February as shown in Figure IV. In case a dense fog does occur while a tug is on the canal, it anchors and waits for the fog to lift.

The network of storm warning systems of this area is one of the best in the southwest. Many private industries have their own radar stations andweather forecasters, especially the oil companies who operate in the Gulf or shallow bays. There is a Government Weather Station in Brownsville, a Navy weather station located in Corpus Christi, while the Dow Chemical Company has its own elaborate storm warning station at Freeport. The Dow Chemical Company, close enough to Galveston to forecast, sends out storm warnings for the immediate area.[14]

Most of the tugs, shrimpers, yachts and ocean-going freighters have marine radio and ship-to-shore telephones by which they can receive the numerous weather broadcasts by the United States Coast Guard. These radios and telephones also serve in a very useful way by enabling the shrimpers to call in to report any sudden storms; also, when they will be in with their catch or for information for the drawbridge tenders, so traffic will not be congested near a bridge where the channel narrows considerably.

Radar is the chief instrument in tracking and spotting the thunder storms and line squalls which are more frequent in the summer months. King's Ranch, just south of Corpus Christi, is believed to have radar in helping to track storms in that area.[15]

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[14] Hildreth, op. cit.

[15] Hildreth, op. cit.

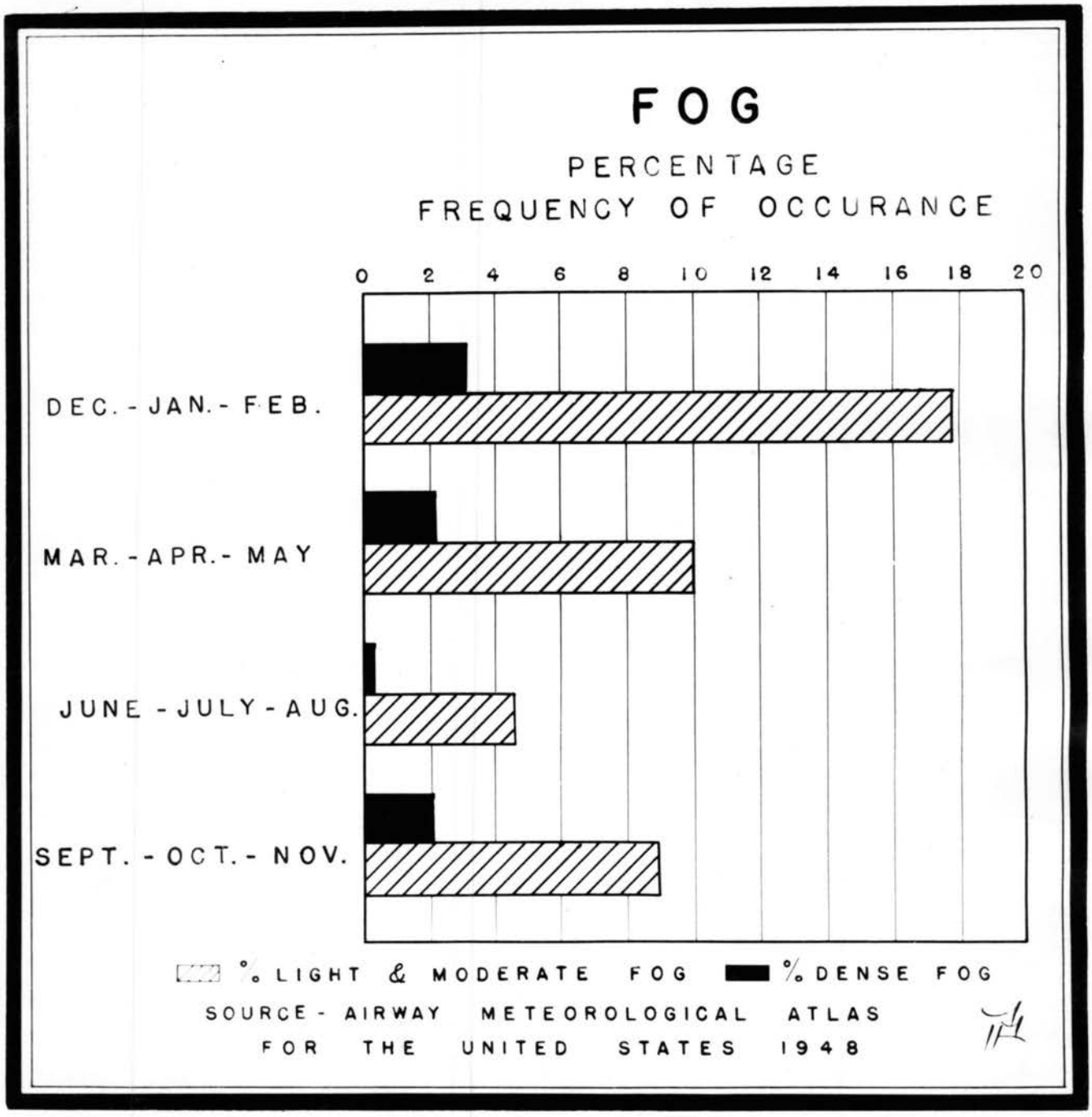
FOG
PERCENTAGE
FREQUENCY OF OCCURANCE
0 2 4 6 8 10 12 14 16 18 20
DEC. - JAN. - FEB.
MAR. - APR. - MAY
JUNE - JULY - AUG.
SEPT. - OCT. - NOV.
% LIGHT & MODERATE FOG
% DENSE FOG
SOURCE - AIRWAY METEOROLOGICAL ATLAS
FOR THE UNITED STATES 1948

Figure 4

Observation stations for hurricanes use pilot balloons, ravin and radiosonde to obtain upper-air data vital to hurricane study. The Navy uses the PB 4Y-2 and the Air Force uses the WB-2 airplanes to spy on and track these tropical storms.[16]

The many industrial plants located on or near the Intracoastal Canal as well as many types of ships, are troubled by corrosion from the action of salt water of the Gulf of Mexico. This is a serious problem to the many car owners in this area. The writer saw one method of combating this condition and that was a fresh water shower bath for the automobiles as they left Padre Island (cost 50¢) and similar devices located in many other strategic locations similar to Padre Island. Another method to prevent rust is to have a heavy coating of wax on the upper surface of the car and a good undercoating. The machinery is constantly painted with red lead or greased to prevent rust. A comparatively new product, plastic, is sometimes sprayed on the metal surfaces of the machinery and different items on small pleasure craft which prevents rust and saves labor for the boat owner.

It is readily seen after viewing climate in general, the many advantageous factors which the Intracoastal Waterway has to offer. Even though the wind is the most important single dangerous factor, it is plain that barge traffic and small craft would operate quite a few days less if they relied wholly on the Gulf itself, notwithstanding the damage some vessels would be sure to incur from the many sudden storms. The waterway assures a year-round operation for any type vessel in addition to the comforts of the crew and less wear on the ship's equipment.

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[16] Andrew H. Brown, "Men against the Hurricane," National Geographic, October, 1950, p. 556.

CHAPTER III

PHYSIOGRAPHY OF THE TEXAS COASTAL PLAIN

General Topography and Geology

The intracoastal Waterway is located in the Gulf Coastal Physiographic province. This province may best be described as, "The lowland bordering the Atlantic Coast of the United States and Mexico and is one of the most clearly defined physiographic provinces of the continent."[1] Very few topographic features relieve the monotony which is characteristic of this extensive area in this lowland province. (Figure V). In Texas, the inner boundary varies from 50 to 350 miles and the inner margin rises to an elevation of 1,000 feet.[2] Bordering the coast are several islands or "sand reefs," the result of wind action piling sand into low ridges and hills with a variation in altitude.

The geological history of the Texas Gulf Coastal Plain and the Texas shore line is comparatively simple. The coastal prairie region of southeast Texas is a deltaic coastal plain.[3] A palmate series of irregularly branching, broad, low, sand ridges in Harris, Fort Bend and Brazoris Counties represent a delta of the ancient Brazos River. The fan-shaped

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[1] Wallace W. Atwood, The Physiographic Provinces of North America, (New York: Ginn and Company, 1940), p. 25.

[2] Ibid., p. 27.

[3] Donald C. Barton, "Deltaic Coastal Plain of Southeastern Texas," Geological Society of America, 1930, p. 359.

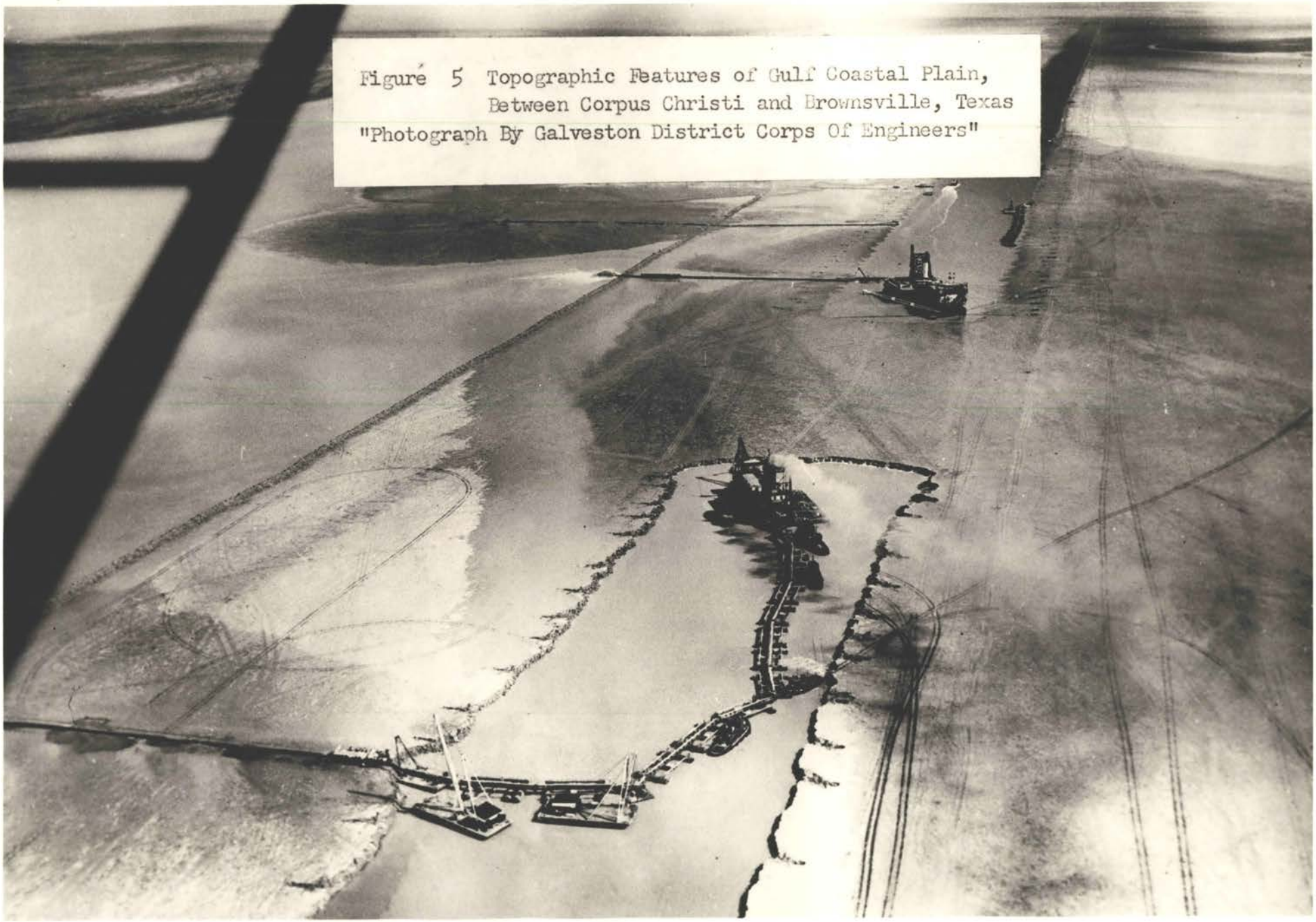

Figure 5 Topographic Features of Gulf Coastal Plain,
Between Corpus Christi and Brownsville, Texas
"Photograph By Galveston District Corps Of Engineers"

fronts of these ancient deltas is reflected in the bay and lagoon coast line of Jefferson, Chamber, Galveston and Brazos Counties.[4]

Deltas spread eastward, southward and southeastward on the coastal prairies, are almost featureless and are in extreme youth. The western shore of Galveston Bay, the northern shore of West Bay, and the northern shore of Matagorda Bay picture the convex front of the ancient Brazos delta. The ancient Brazos and Trinity deltas are fairly large, very much larger than the present day, Brazos and Trinity Rivers. The Trinity delta is of about the same size as the delta of the Mississippi River proper below New Orleans, that is, exclusive of the delta of the Bayou la Fourche system of distributaries. The ancient Brazos delta is, perhaps, slightly smaller.[5] "That physiographically, the upper layer of the coastal prairie zone is a deltaic coastal plain, not a marine coastal plain, and that the indentale bays, such as Galveston Bay, are the inter-delta-interdistributary bays of a deltaic coastal plain and not drowned erosion valleys."[6]

Detrital materials eroded from mountains and lands to the north and northwest were spread in broad apron sheets under shallow marginal continental seas. Table IV shows how this situation was possible.

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[4] Ibid., p. 365.

[5] Barton, op. cit., p. 372.

[6] Ibid., p. 367.

TABLE IV

ACRE FEET ANNUAL SILT LOAD OF VARIOUS TRIBUTARIES OF THE GULF OF MEXICO[7]

Brazos R. Rosenburg 1925-30	San Antonio R. Falls City 1928-30	Nueces R. Three Riv. 1928-30	Colorado R. Tow 1928-30	Colorado R. Columbus Estimate	Miss. R ------ ------
19,310	186	553	3,447	6,894	171,510

The slope of this deposition is so gentle that a slight submergence of the land would bring the sea well in toward the interior. Even today, a submergence of the marginal plains of about 450 feet would make Dallas a seaport, while an elevation of 50 feet would place Galveston fifty miles in the interior.

TABLE V

ALTITUDES OF PRINCIPAL TEXAS CITIES AND COUNTIES[8]

Beaumont-Jefferson Co.	24'
Port Arthur-Jefferson Co.	34'
Houston-Harris Co,	55'
Galveston-Galveston Co.	20'
Freeport-Brazoria Co.	15'
Port Lavaca-Calhoun Co.	19'
Aransas Pass-San Patricio	20'
Rock Port-Aransas Co.	20'
Corpus Christi-Nueces Co.	35'
Waco-McLennan Co.	427'
Dallas-Dallas Co.	512'
Longview-Gregg	339

According to Dr. E. H. Sellards, Director of the Texas Bureau of Economic Geology, the geologic structure of Texas is influenced by two mountain belts, the Cordilleran of the Trans-Pecos area with northwest-

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[7] Horace G. Richards, "Marine Pleistocene of Texas," Geological Society of America, December, 1939, p. 1893.

[8] "Altitudes of Principal Texas Cities and Counties," Texas Almanac, 1943-1944, pp. 98-102.

southeast regional trends, and the subsurface Appalachian folds which have a prevailing northeast-southwest trend. The strata composing the Gulf Coastal Plain lie in a monoclinal attitude with a gentle dip toward the coast.[9]

By middle Lower Cretaceous time most of Texas was covered by the sea. In this sea the Commanche series, predominantly limestone, was deposited to a maximum thickness of more than 3,000 feet. In this section the sediments of the coastal plain form a wedge-shaped mass along the Atlantic and Gulf region, with its feather edge of sediments along the inner border of the plain. The maximum thickness of the thick end of the wedge, along the coast, is not known.[10] As evidenced by wells, in Florida 3,000 feet of limestone, presumably of Eocene age, has been penetrated in Sumter County.[11] Beds of Eocene age, overlaid by beds of Oligocene age, have been identified in wells sunk around the Damon Mound ans West Columbia salt domes, Brazoria County, Texas, at depths of 4,000 to 4,500 feet, but these beds are uplifted around the borders of the dome.[12] In 1920 a geologist recorded Pleistocene fossils from the following wells near Beaumont:

1) Bayou City Oil Company, Beaumont, Shells at 600 feet
2) Spindle Top Oil Well near Beaumont, Shells at 390 feet

There is evidence of exposure of Pleistocene shells at Houston Point on Galveston Bay and Pleistocene oyster reefs near Port Lavaca. "Dredging from the Intracoastal canal about 6 miles east of the Galveston

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[9] Lloyd W. Stephenson, "Major Marine Transgressions and Regressions and Structural Features of the Gulf Coastal Plain," American Journal of Science, October, 1928, p. 292.

[10] Ibid., p. 888. [11] Ibid., p. 889. [12] Ibid., p. 890.

Point-Bolivar Ferry encountered numerous shells, and about 16 species were identified from the spoil banks." All of the species are at the present living in the coastal waters of Texas. The surface of Texas, and especially this area, is deltaic in origin and may be correlated with the Pleistocene deposits of southwestern Louisiana near Lake Charles.[13] The shells from the water wells near Rockport, Aransas County, represent a more marine and deeper water condition than any of the other localities mentioned.

These records, although incomplete, show that a thick mass of sediments make up both the lower and older and the upper and younger parts of the coastal plain deposits. Even though the thickness varies greatly, the maximum thickness of this section doubtless exceeds 15,000 feet and some geologists say it might be 25,000 feet in thickness.[14]

We may, therefore, picture the deposits of the Gulf Coastal Plain as a mere veneer of marine sands, clays, marls, and chalks, sediments of Cretaceous, Tertiary and Quantermary age on a basement of more or less folded, eroded, and baseleveled pre-Paleozoic and Paleozoic Rock. (Figure VI). The upper surface of this area is deltaic in origin from the numerous rivers that transverse this region on their way to the Gulf of Mexico. (Figure VI).

Off-Shore Bars

Padre Island and Mustang Island constitute one of the longest off-shore bars in the world.

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[13] Richards, op. cit., pp. 1889-1890.

[14] Ibid., p. 1892.

Figure 6 Topographic Features of Gulf Coastal Plain
Near Freeport, Texas
"Photograph By Galveston District Corps Of Engineers"

The coast of Texas and much of the Gulf illustrates the history of a typical shoreline of emergence. When a former sea floor emerges by gentle uplift, it becomes a nearly flat coastal plain of sea-floor sediment. Waves working over the shallow water drag heavily on the bottom and pick up loose sand, gravel and pebbles, which, when their power is diminished, gradually deposit and build up a narrow submarine ridge parallel with the shoreline just within the line of breakers.

Steady accumulations broaden and heighten this ridge until storm waves eventually build the deposit above sea level. This, the work of wind and waves, forms a low, long sandy island, known as an off-shore bar. Often these islands become elongated by further wave action, and gradually close the wider openings to the sea, except where the velocity of river waters maintain across the bar, with scoured channels to the sea. Shallow lagoons occupy the area between these off-shore bars and the mainland. Both the Gulf and Atlantic Coasts of the United States, recently emerged from the sea, consist of an almost continuous series of off-shore bars and lagoons developed on a gigantic scale.

Where these protected lagoons cross the low interstream divides, engineers have constructed channels of considerable size and this better utilizes this characteristic physiographic feature of our south and eastern shores.

Through this area, with the protection of off-shore bars, the Intracoastal Waterway has developed into an industrial highway of the 20th century.

CHAPTER IV

PROBLEMS OF MAINTENANCE AND OPERATION

The different sections of the waterway have been constructed by various types of earth-moving equipment available at the time, although the greater part of the present waterway is the work of hydraulic dredges owned by the Government and by dredging contractors. (Figure VII).

The modern waterway has been constructed by: (1) hydraulic pipeline dredges, (2) dipper dredges, (3) draglines, (4) power shovels and similar modern excavating equipment, including heavy-duty type construction equipment used for foundation and concrete construction required in constructing the various locks which form a part of the waterway system.[1]

After the completion of any construction project the problems of maintenance become first in importance if the continued operation of the project is to be successful. Maintenance of the inland waterway system is a major problem within itself.

Heavy shoaling in the Intracoastal Waterway at the Brazos and Colorado River crossings due to rises in the rivers with resultant interruptions of considerable duration to traffic indicated a necessity for floodgates at these crossings. These two locks were placed into operation August 2, 1943, and August 7, 1944, respectively. Experience to date in the operation of the floodgates has indicated that shoaling

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[1] Department of the Army, Corps of Engineers, The Gulf Intracoastal Waterway. Bulletin , SWNVI 000.7, (Washington: Government Printing Office, 1950), p. 6.

during rises of short duration is usually negligible when the floodgates are opened following the rise. During major rises in the rivers, heavy shoaling may occur in the forebays of the floodgates and, at times, some dredging may be required before traffic can readily pass through the floodgates. Ordinarily sufficient depth to accommodate traffic following a major rise can be provided in from 4 to 6 days of dredging.[2] Just inside of these floodgates away from the river channel, dredging to thirty feet in depth usually brings it 18 feet below the average depth of the canal, thus affording further precaution of delays during floods. The depth of the channel under the Padre Island Causeway bridge is 15 to 20 feet in depth. The bridge operator there explained that the wind and tidal influence kept the channel to that depth.

Periodic surveys, made by field personnel, determine the rate of shoaling in critical reaches of the waterway. In making the surveys it is necessary that the entire length of the project be examined thoroughly by cross sectioning and "fathometer" sweeping to locate the shoaled areas. When the periodic surveys indicate that dredging will be required to restore the channel to navigable dimensions, a detailed survey is made for the purpose of preparing plans and specifications for dredging the critical area.

Under ordinary conditions the mean tidal range in the waterway varies from 1 to 2 feet.[3] In most sections the tide is largely dependent on the force and direction of the wind. Strong northerly winds that occur principally during the winter, depress the water surface as

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[2] Statement by Lock Operator, personal interview, August, 1951.

[3] Bulletin, SWVI 000.7. op. cit, p. 1.

Figure 7 Dredge on Gulf Intracoastal Waterway
"Photograph By Galveston District Corps Of Engineers"

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much as 2 feet or more below mean low water, and southerly winds have the opposite effect. Severe hurricanes have caused a rise of water of 10 feet or more above mean low water in some localities.[4] To protect the navigation at various points from tidal and wind effects, irrigated areas from salt water intrusion, and the waterway from shoaling, locks or floodgates have been constructed.

As the Intracoastal Waterway winds its way along the Texas coast it passes through several bays and lagoons. The U. S. Engineers prefer to cut canals through dry lands instead of these shallow bays for numerous reasons, but the main reason is maintenance. For example, where the Intracoastal Waterway crosses the shallow lagoons, sometimes the lagoons are from 1 to 2 feet in depth and as the great force of the propellers from the tugs create a vacuum that extends visibly forward of the bow, producing waterfalls on either hand as the water summoned into the canal by the vacuum, tumbles over the barely covered banks, no one knows how much dirt a boat is washing into the channel by pulling in all that bay water as they pass. The initial cost in constructing the canal through this type area is lower but the maintenance is greater in the long run.

It is estimated that the waterway between the Sabine River and Brownsville, Texas, will require an annual expenditure in excess of $1,000,000 to maintain the project dimensions.[5]

Personnel

The personnel working on the Intracoastal Waterway fall into two distinct groups: (1) Civil Service--lock operators and some bridge

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[4] Bulletin, SWNVI 000.7, op. cit., p. 9.

[5] Bulletin, SWNVI 000.7, op. cit., pp. 11-12.

tenders, dredge operators, engineers of the U. S. Army and their many maintenance divisions, and (2) private operators--tug operators and crews, dock hands, etc.

Based on the most recent reports of the Federal and State social security systems, the United States Department of Labor has unofficially estimated that, exclusive of the Great Lakes, 46,000 persons are employed by inland water carriers and operators of which about two-thirds are vessel personnel. It is believed that the total employees compensation of the Inland Water transportation industry, exclusive of the Great Lakes, will exceed $200,000,000 annually.[6]

Along the Gulf Intracoastal waterway many people are employed in various positions. Some are employed part-time and live near the canal and others are full-time employees.

It is clearly evident that the employment function of inland waterway transportation materially affects a large group of persons beyond the mere confines of its own activities as effectively as it does those directly employed therein.

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[6] Inland Waterway Transportation in America. (Washington: Government Printing Office, 1948), p. 15.

CHAPTER V

ECONOMIC ASPECTS OF THE GULF INTRACOASTAL WATERWAY

Use of the Gulf section of the Intracoastal waterway increased as rapidly as progressive improvement of its various sections linked the navigable channels in streams tributary to the Gulf of Mexico to the national network. It soon became evident that the waterway afforded an economical and a natural mode of transportation for the wide variety of commodities produced or consumed in the Gulf region and as a result, commerce on the waterway as a whole has far exceeded the most optimistic expectations.

The waterway is adapted to handling commodities which may be economically transported by barge. While oil on its way from the oil fields of Louisiana and Texas to refineries constitutes the largest single item of traffic, the advantage of the waterway in the transportation of refined petroleum for great distances was demonstrated during World Was II. Iron and steel, sulphur, sugar, pulpwood, sand and gravel, shell, timber products, rice, salt and a multitude of other commodities constitute an ever increasing tonnage. In addition to large commercial users, the Intracoastal waterway has also benefitted many small-craft owners. It is of particular advantage to the many fishing boat owners engaged in the important sea-food industry on the Gulf coast, who use the sheltered route between coastal points during stormy weather.[1]

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[1] Department of the Army, Corps of Engineers, The Gulf Intracoastal Waterway. Bulletin, SWNVI 000.7 (Washington: Government Printing Office, 1950), p. 10.

The importance of the Gulf Intracoastal Waterway between the Sabine River and Brownsville, Texas, is evidenced by the rapidly increasing amount of commerce handled during the 10-year period from 1939 to 1948, inclusive. During the calendar year 1939, the commerce handled in this section of the waterway amounted to 3,129,000 tons. It increased to 17,827,000 in 1944, the peak war year when this section of the waterway was handling an appreciable amount of commerce normally transported in deep-draft vessels. The commerce decreased somewhat after the war to 13, 976,000 tons in 1946, then increased to 15, 239,000 tons in 1947 and to 19,670,000 tons in 1948. The 1949 tonnage decreased to 18,317,154, and while commercial statistics are not available for 1950, a preliminary estimate indicated that the total tonnage will exceed that handled in 1948 and 1949, respectively.[2]

It would be impracticable for the writer to go into details of the commercial and industrial use of every city on the waterway in this area, consequently a general picture is presented, which gives some facts and figures concerning the most important points. In August, 1951, the writer made a field study of this area over a period of two weeks and thus was able to gather the highlights of industry.

Dr. Edwin J. Foscue classified the industries appearing in the area into six types: (1) "Extractive--such as withdrawing oil and gas, mining sulphur and salt, and dredging oyster shells, (2) Refineries--producing gasoline, lubricating oils and similar products from petroleum and natural gas, (3) Heavy chemical industries--utilizing petroleum, natural gas, sulphur, salt, or oyster shells as raw materials, to produce

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[2]Bulletin, SWDVI 300.7, op. cit., p. 10.

such items as acetate salts, formaldehyde, and other chemicals from natural gas, sulphuric acid from the large supplies of sulphur, synthetic rubber from petroleum and nylon salts from natural gas, (4) Metallurgical industries--extracting magnesium salt from sea water and refining it into metallic magnesium, or producing zinc, tin, iron, and steel from ores or concentrates brought in from a distance, (5) Wood products industries--including sawmills and pulp and paper mills, and (6) Food products industries, such as rice cleaners and processers, sugar refineries."[3]

Location of Industry

In this area the modern oil industry began in 1901 with the bringing in of the large and famous "Spindle Top." The annual ship tonnage for the trio, Beaumont, Port Arthur, and Orange averages 40 million dollars, about 60 per cent in oil and gas products. Annual industrial product value is $500,000,000. This area also has the largest rice-packing plant in the world. Between Beaumont and Port Arthur (20 miles) are six of the world's largest oil refineries, producing 16 per cent of the U.S. production of 10 per cent of the world's refined products.[4]. . . The three companies, The Texas Company, Gulf Oil Company and Atlantic Refining Company, produce 464,000 barrels of oil per day.

Several outstanding industries are listed by the following cities:[5]

Beaumont:
(1) Magnolia Petroleum Refinery
(2) Southern Acid and Sulphur Company
(3) Rice Mills
(4) Bethlehem Steel Company's Shipyard (undergoing a $25 million expansion)
(5) Numerous small businesses and barge lines and tugs

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[3] Baldwin J. Roscue, "Industrialization of the Texas Gulf Coast Region," The Southwestern Social Science Quarterly, June, 1950, p. 7

[4] "The Golden Coast," Fortune, October, 1949, p. 83.

[5] Ibid, p. 83-87.

Port Neches:
(1) The world's largest butadiene plant, run jointly by 5 oil companies (Butadiene--a gas which is used in making synthetic rubber)
(2) Jefferson Chemical Company--a $20,000,000 plant owned by American Cyanamid Company and the Texas Company
(3) Sure Oil Refinery
(4) Numerous small business and barge lines and tugs

Port Arthur:
(1) Gulf Oil Company
(2) The Texas Company
(3) Atlantic Refining Company
(4) A large Coke Calcimining Plant
(5) Steel-barrel and tank fabricators
(6) Oyster-shell dredging operators and barges and tugs
(7) Gulf Port Shipbuilding and Drydock Company

Galveston:
(1) Home port for many shrimpers and other type fishing boats
(2) Numerous small shipyards and several shipyards that repair tankers
(3) World's largest sulphur port (over a million net tons annually)
(4) Wheat exporting
(5) Cotton exporting

Manufacturing plants on this Island employ about 10,000 people with an annual payroll of more than $30,000,000.[6]

Freeport:
(1) Dow Chemical Company--Extracting magnesium from sea water

Freeport-Velasco area:
(1) Freeport Gulf Sulphur Company--chief source of sulphur for the numerous chemical industries operated by Dow Chemical Company in that area

Texas City District:
(1) Monsanto Chemical Company
(2) Carbide and Carbon Chemicals Corporation--manufacturing ethyl alcohol, ethyl ether, sulphuric acid, and many other chemicals from hydrocarbons and sulphur
(3) The Pan American Refinery
(4) Republican Refinery
(5) Longhorn Tin Smelter of the Tin Processing Corporation (owned by the government but operated by the Tin Processing Corporation, a Netherlands Company)

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[6] "Galveston Isle of Treasure and Adventure," The Humble Way, March-April, 1951, p. 15.

Port Lavaca:
(1) Aluminum Company of America

Corpus Christi:
(1) Southern Alkali Corporation--producing soda ash and caustic soda, alkali and chlorine
(2) Sinclair Refining Company's refinery
(3) American Smelting and Refining Company--zinc refinery
(4) Corn Products Refining Company--produces corn starch, corn sugar and corn syrup

The foregoing is a picture, although incomplete, of the large industrial section of Texas (sometimes referred to as the Golden Coast) that is located on the banks or near the Intracoastal Canal. These industries have a ready-made highway by using this canal to transport their products to the local, district, national and international markets cheaply and efficiently.

TYPES OF CARRIERS AND OPERATORS

Carriers performing freight services on inland waterways generally fall of three classes: (1) common; (2) contract; or (3) private. Common carriers are those offering their services to the general public for the carriage of practically all kinds of freight at rates and charges published in tariffs on file with the Interstate Commerce Commission. Contract carriers are such as contract to carry the freight, principally bulk commodities, at rates that are not generally published but are made by special agreements with individual shippers and vary with the volume of the traffic offered. Private carriers are proprietary carriers, i.e., the operation of their vessels is performed primarily as a component part of a parent company's business and for the exclusive transportation of such company's materials and products. Passenger carriers on inland waterways are practically all common carriers. Common carriers and some contract carriers (under certain specified conditions) are subject to an

important measure of regulation by the Interstate Commerce Commission as to rates, service, and financial procedures.[7]

An important category of inland waterway transportation, in addition to the line-haul water carriers referred to in the preceding paragraph, comprehends the operators of tugs performing auxiliary or terminal services in harbor areas or public towing upon demand. The services of these operators include the docking and undocking of ocean vessels at wharves, piers or marine ways; the shifting of ocean vessels and barges from one part of a harbor to another; assistance in the bunkering of ocean vessels and salvage operations; lighterage; and the general towing of floating equipment including specialized types such as dredges, pile drivers, derrick barges, oil exploration barges and oil well drilling outfits, compressor barges, and salvage craft. The railroads also conduct extensive marine operations in many harbors through the use of tugs, ferryboats, car floats, lighters, car ferries, scows, hoisting derricks, and miscellaneous floating equipment, which it is understood aggregate almost 2,000 units.

Another group of operators having large numbers of floating equipment, but whose operations do not involve the transportation and handling of freight, are the construction and dredging companies engaged in inland waterway construction and bridge building. Their equipment consists of many types including towboats, dredges, dredge tenders, derrick barges, pile drivers, work boats and launches, quarter boats, diving barges, floating cranes, pump barges, and welding and compressor barges.[8]

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[7] Inland Waterway-Facts and Figures. (Washington: Government Printing Office, 1950), p. 19.

[8] Inland Waterway-Facts and Figures, op. cit., p. 21.

TYPES OF COMMERCIAL CRAFT

In transversing the 270 miles from Corpus Christi to Beaumont on the Intracoastal, one is likely to see a varied assortment of commercial craft. These are: the ocean-going freighters (more numerous between Beaumont and Galveston), tugs, barges (steel and wooden), shrimp boats, numerous other varieties of fishing craft, and small boats chartered to the fishermen.

Through carefully conducted research and experimentation there have occurred many significant developments in the modernization and improvement of the design and efficiency of inland waterway floating equipment. From modern engineering, model basin testing, careful operating analysis have removed the guesswork from inland waterway vessel design and construction with the result that inland waterway transportation offers more service economically than ever before.

Since space will not permit a description of all of the types of vessels, the writer has chosen to describe the new tugs and barges.

Barges

The non-self-propelled equipment of the inland waterway carriers and operators has come in for its share of modernization. Practically all of it now in use on inland waterways is of all-steel construction. Improvements to barges are frequently being made to increase their efficiency, provide better service to the shipping public, afford greater safety of operation, and reduce the possibility of loss or damage to the cargoes carried.

Included among such improvements are the use of welded steel hulls, rounded corners to reduce the damage caused by barges to other units of a tow or fleet; rake ends, shaped to secure the greatest tonnage carrying

capacity consistent with economical towing cost; serrated framing to increase structural strength; rounded gunwales to eliminate rough edges and reduce damage to tow lines; flanged headlogs strong enough to resist all normal service bumps and keep damage to a minimum in the event of extreme impact from accidents; scientifically designed skegs to insure a barge maintaining its course when being towed astern; steel rolling hatch covers to protect cargo from the elements and allow maximum clearance for loading and unloading; and specially designed hopper-type hulls to enable the handling of bulk cargo by buckets and clam shells efficiently, with the minimum of damage to the barges.[9]

All of these features reduce repair and maintenance cost to the owners and operators and contribute to the economy of inland waterway transportation.

Because of the uniformity in the dimensions of the inland waterway locks, through which tows or barges must pass and a greater ease with which tows can be made up and handled, the standardization of barge sizes has been created in the last few years. Standardization enables the mass production of barges by assembly line methods at lower cost per unit than when many varied shapes and sizes are required, and permits interchange between the various towing companies, both for long and short hauls. Another advantage of the uniformity of size in the construction of the new steel barges is that it affords a tow of integrated units which has proven its adaptability for the movement of automobiles, petroleum products and other commodities. In connection with this method the barges are fitted together so that units of two or more will have the same streamline effect

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[9]Inland Waterways-Facts and Figures, op. cit., p. 31.

as one large barge, thereby reducing the power necessary to tow the barge at a given speed.

Tripping is the term that means the breaking up of long, heavy tows where the current is swift, and hauling the load upstream a unit at a time. In this manner, canal skippers get long strings of barges across such big bisecting rivers as the Colorado, the Brazos and the Trinity when these rivers are roaring with flood waters. The new articulated tows can reduce the transportation costs as much as 25 per cent, depending upon the type of traffic involved. In this area, with its long, straight stretches of waterway, this saving is evident.

One of the first applications of high speed articulated tows for the transportation of dry bulk cargo on inland waterways occurred in 1949, with the building of six large-sized covered cargo barges in integrated units of two barges each, for operation between points on the Gulf Intracoastal Waterway and the Mississippi River System in the movement of sulphur, salt, and chemicals. Special provisions have been made for the carriage of automobiles on return trips downstream.[10]

For the loading of automobiles, a doorway has been provided in the forward bulk of each of the integrated barges. Automobiles can be driven from the dock over ramps to the forward rake deck of the barge and then into the hold where there is space for four rows of 12 each. The hatch covers have been strengthened and steel channels have been welded to their tops for the wheels of automobiles so that four additional rows of 12 automobiles each can be transported thereon, consequently increasing the total load to 96 per barge.[11]

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[10] Inland Waterway-Facts and Figures, op. cit., p. 33.

[11] Ibid., p. 37.

These barges, of welded steel construction throughout, 240 feet long, 50 feet wide, and 11 feet, 8 inches deep, have specially designed weather tight rolling hatch covers to facilitate loading and unloading. Each barge can transport approximately 2,500 net tons of dry cargo.. This new design permits the barges to be pushed by a fast towboat in tandem, the square ends of two barges are butted to form a single streamlined barge 480 feet long of 5,000 net tons. Two of the barges, fully loaded and in tandem, can be towed between 10 and 11 miles per hour in contrast to normal towing speeds of 3 to 5 miles per hour for older type barges.[12]

Bethlehem shipyards are responsible for several of these new type barges, such as the types for carrying bulk oil, water, ore, sulphur, etc. These range in size from 92 ft. x 26 ft. x 6 ft. to an integrated tow of three oil barges 290 ft. x 50 ft. x 11 ft. Other barge construction includes a group of ore vessels 267 ft. x 52 ft. x 18 ft. 6 in., each to carry 4,000 tons of iron ore.[13] Another Bethlehem speciality is the submersible drilling barge for coastal oil country use and many of them are dotting the shallow lagoons and bays today in Texas.

Tugs

Improvements in hull design have brought about increased speed of towboats with a given amount of power and have helped in the towing and handling of barges. The most noticeable change in design is the modeled bows in contrast to the scow bow, which improves free running speed and steering, an important factor that reduces the time lost in making up tows of barges. The new modeled bow tends to cast drift to the sides of

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[12] Ibid., p. 33.

[13] Bethlehem at Beaumont. (Bethlehem Steel Company, 1950), p. 10.

the boat clear of the propellers so as to minimize propeller damage. Another improvement is the use of screw propellers in contrast to the old stern paddle wheelers.

The Diesel engine is perhaps the factor which has most influenced the modern trend in towboat design. This engine, a more compact unit requiring less space than a steam engine of equal power, can be operated by fewer personnel and generally at lower fuel cost. Consequently, towboats equipped with Diesel engines can be built to smaller over-all lengths than a steam towboat of identical power. There is also a saving in the capital outlay.

Typical of Diesel-powered tugs recently built for operation on the waterways and in the harbors of the Gulf and Atlantic coasts is a single-screw vessel with a length of 102 feet, a beam of 24 feet, a hull depth of 12 feet 4 inches, and a normal draft of 10.5 feet. Propelled by a 1,000-horsepower Diesel engine, it has accommodations for a crew of ten and is equipped with ship-to-shore radio telephone and a radio direction finder. When running light, the tug's speed averages about 10.5 knots per hour.[14] Wade Towing Company's queen, the "Mohawk," operating on the Gulf Intracoastal Canal cost $250,000 and is 92' long, 23' beam and 11' draft. There are many smaller Diesel and gas powered tugs that push or tow only one to three small barges in this section.

Some of the improvements for more efficiency from the personnel of these tugs are: (1) unobstructed vision so the pilot is enabled to see all sections of the boat, (2) radar, (3) telephone connection to the engine room, (4) front windows hinged and sloping inward to eliminate

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[14]Inland Waterway-Facts and Figures, op. cit., p. 26.

the glare from the sun and reflections from shore lights, (5) properly placed rudder control levers to indicate at all times the position of the rudders, (6) electrically controlled searchlights so placed as to prevent the blinding of the pilot, and (7) a telotalk system to several locations on the boat and to the head of the tow.[15]

An example of the initial outlay of one of these new Diesel tug boats is the cost of a triple-screw towboat built about two and one-half years ago for operation on the Mississippi River System at a cost of approximately $650,000. It has a length of 140 feet, beam of 38 feet, and a hull depth of 9.5 feet, and is powered by three Diesel engines developing 1,100 horsepower each, a total of 3,330 horsepower.[16]

Through a survey of the principal shipyards, which build inland waterway floating equipment, made recently by the American Waterways Operators, Inc., it has been estimated that the privately-owned inland waterway transportation industry spent $62,000,000 in 1948 and $47,000,000 in 1949 for new towboats, tugs, and barges. Thus, in a period of only two years, a total of $109,000,000 was expended for new vessels to improve the efficiency of inland waterway transportation and provide better service.[17]

Commodities

Millions of tons of raw materials and finished products are transported over the inland waterways of the United States daily. Such commodities are: asphalt, automobiles and motor trucks, ore, canned goods,

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[15] Ibid., p. 31.

[16] Inland Waterway-Facts and Figures, op. cit., p. 26.

[17] Ibid., p. 23.

chemicals, clay, coal, cotton, fertilizer, grain, iron, steel, logs, lumber, machinery, paper, petroleum, sand, stone and wood pulp.

These commodities fall into two distinct categories: (1) bulk freight such as coal, coke, stone, sand and gravel, cement, grain, sulphur, petroleum and petroleum products, and liquid and dry chemicals, and (2) package freight such as canned goods, paper, sugar, nails, beverages. The movement of bulk freight is especially adaptable to inland waterway transportation, in fact, according to the official statistics of the Corps of Engineers, United States Army, over 90 per cent of the total traffic of all inland waterways is the transport of bulk freight.[18] This does not include the Great Lakes.

The Gulf Intracoastal Waterways is one of the most important inland waterway routes for the transportation of petroleum and petroleum products, which, in 1946, amounted to 16,447,420 net tons or 80 per cent of the total traffic.[19] Many other commodities move over the Waterway during the year in a large volume including acetone, acids, asphalt, forest products, general merchandise, iron and steel, paper, pig iron, pulpwood, salt, sand and gravel, sea shells, shale, slag, soy beans, stone, styrene, sugar, and sulphur.[20] Much of the traffic of the waterway moves to and from numerous ports on the Mississippi River and its tributaries.

Table VI shows the total tonnage of the Gulf Intracoastal Waterway for the calendar year 1948, which is the latest official information available. The tabulation also illustrates the varied commodities making

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[18] Inland Waterway-Facts and Figures, Op. cit., p. 13.

[19] Ibid., p. 13.

[20] Inland Waterway Transportation in America. (Washington: Government Printing Office, 1948), p. 6.

up the traffic of the inland waterways, Gulf Section.

TABLE VI

CARGO-GULF INTRACOASTAL WATERWAY[21]

Net Tons (2,000 pounds):

Appalachee Bay, Florida, to the Mexican Border. 27,866,339 tons.

Principal Commodities:

Sea shells, coal, petroleum and petroleum products, iron and steel pipe and fittings, iron and steel articles, sulphur, acids, clay, machinery and machines, pulpwood, chemicals, alcohol, sugar, limestone, logs and salt.

Table VII shows some uses of the Intracoastal Canal. The writer listed in the table only type representatives rather than to include all of any one type. For obvious reasons some companies were reluctant to answer questions number 9, (a) and (b), and this explains the blanks that make the table seem incomplete.

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[21] Inland Waterway-Facts and Figures, op. cit., p. 17.

TABLE VII

OIL COMPANIES

	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"
Destination of finished products shipped out by waterway	U.S. East Coast, Foreign Ports	Texas City & Port Arthur	Texas, Gulf Coast, U.S. E Coast	U.S.East Coast, Texas Coast	———	World-wide	Gulf Coast Area	———
Is waterway chief source of transportation?	Yes	Yes	Yes	No	No	No	No	Yes
Percentage of cargo shipped via intracoastal waterway	100%	85%	60%	3%	40%	———	———	90%
Value of raw materials coming in via waterway to company (annual)	$400,00	$1,400,000 (est.)	———	———	———	———	———	———
Value of finished products shipped out by company	———	———	———	$200,000	$1,000,000	———	———	———

TABLE VIII

VARIOUS TYPES OF COMPANIES

	"I"	"J"	"K"	"L"	"M"	"N"	"O"
Type of Company	Manuf. Spices	Rice Mills	Retail Agri. Impl.	Mfgr. of Trucks	Shell Store	Steel Forge	Syn. Rubber Mfg.
Destination of finished products shipped out by waterway	____	Cuba	____	New Orleans, Memphis	____	____	Midwest and East
Is waterway chief source of transportation?	No	No	No	Yes	No-would be if connection possible	No	No
Percentage of cargo shipped via Intracoastal Waterway	10%	10%	30%	70%	____	10%	____
Value of raw materials coming in via waterway to company (annual)	$30,000	____	$60,000	$240,000	____	____	____
Value of finished products shipped out by company	____	____	____	____	____	____	____

Long and Short Hauls

Most of the commodities shipped via the Gulf Intracoastal is bulk freight, that is: sea shells, coal, petroleum and petroleum products, iron and steel articles, sulphur, acids, clay, chemicals, sugar, limestone and salt. Coal, petroleum and petroleum products, acids, clay, chemicals, sugar, limestone and salt, lead and lead ores and zinc concentrates make up the larger percentage of commodities of long hauls. Shipments that originate in Corpus Christi, Port Lavaca, and Freeport, Texas, have destinations that are as far-reaching as : St. Louis, Memphis, Chicago, St. Paul, other cities on the Great Lakes, and even New York City, the latter being a trans-shipping point for the International markets.

Of the short hauls, most of the commodities fall into products for domestic and commercial use. Some of these products include: sea shells, coal, iron and steel articles, clay, sugar, cotton, lumber, and fruits from the Rio Grande Valley near Brownsville, Texas.

Economy and Competitive Rates

Improved inland waterways have been conducive to the development of efficient low-cost water transportation with the result that the economies attained have been made available to the users thereof substantial savings in freight rates and charges.

The steel barges now in operation on the improved Intracoastal Canal and other inland waterways hold three or four times as much freight as the ordinary old-time packet boat. While a tow of seven or eight 1,000 ton barges would perhaps be the average size, today powerful diesel towboats regularly handle tows of from 15 to 20 steel barges at

one time, containing from 15,000 to 20,000 tons of freight, the equivalent of 300 to 400 loaded 50-ton railroad cars or 5-40 car trains.[22]

Bulk commodities, generally transported on inland waterways in barge lots, enable the water carriers to effect low operating costs and to maintain and charge port-to-port rates that are much lower than those applicable either via rail or on the common-carrier inland waterway traffic which moves in smaller quantities per shipment. These rates, applying as they do on barge or volume lots, reflect the economy of water transportation to the fullest extent and afford shippers substantial savings in freight charges as compared with the all-rail charges.

Some bulk commodities are transported so economically that the railroads are unable to offer effective competition. Complete information as to the total savings in freight rates via all inland waterways cannot be obtained because of the many complexities involved in the distribution and marketing of commodities. Reliable data, however, indicate that the direct savings in freight rates via inland waterway routes as compared with the corresponding all-rail rates, average between $1.00 and $4.00 per net ton and sometimes the direct savings amount to as much as $8.00 or $9.00 per net ton, depending upon the characteristics and volume of the commodities involved.[23]

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[22] Inland Waterway Transportation in America, op. cit., p. 10.

[23] Inland Waterway-Facts and Figures, op. cit., p. 40.

TABLE IX

COMPARATIVE TRANSPORTATION COSTS, 1937 AND 1946[24]

Types of Transportation Carriers	Million Ton Miles	Per Cent	Cost per Ton Mile 1937	Cost per Ton Mile 1946
Water	10,378	87.92	$ 0.00063	$ 0.00082
Railroads	244	2.07	0.01640	0.01695
Pipe Line (crude)	744	6.30	0.00477	0.00344
Pipe Line (gasoline)	373	3.16	0.00527	0.00445
Truck	64	0.55	0.04873	0.06125

A few examples of the cheaper rates, yet fast service, are given by the following instances:

A load of automobiles leaving St. Louis on Monday docks in Houston Friday, at a saving of $35 per car.[25] Another instance, even though on another waterway, gives further comparison. Bulk freight could be compared to the bulk freight on the Gulf Intracoastal Waterway. Grain is transported in barge loads from Morris, Illinois, to Chicago, Illinois, via the Illinois Waterway for 3.125 cents per hundred pounds as compared with an all-rail rate of 14.84 cents per hundred pounds.[26]

The savings in freight charges on traffic transported by barge on the Tennessee River in 1948, according to official Government estimates, was $4,000,000.[27]

The writer was unable to locate comparative figures on freight rates on the Gulf Intracoastal except in the one case, but the above

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[24] Erich W. Zimmerman, World Resources and Industries,

[25] "The Golden Coast," op. cit., p. 93.

[26] Inland Waterway-Facts and Figures, op. cit., p. 41.

[27] Ibid., p. 4..

comparison holds true on all inland waterways.

While both common and contract inland waterway carriers have port-to-port rates between all important ports generally lower than the corresponding rates of land carriers, savings in freight rates via inland waterway routes are not confined to port-to-port movements. For instance, joint rail-and-water rates, differentially lower than the corresponding all-rail rates apply, in connection with common carriers operating on inland waterways, to and from points in extensive interior areas. These differential rates are applicable on almost every commodity transported by the railroads.[28]

According to John W. Fulbright, President of the Intracoastal Canal Association of Louisiana and Texas, the cost to ship a bargeload of cotton or coal from one point to another on the canal is frequently 20 per cent cheaper than the cost of shipping the same amount by rail. Yet often the railroads, while seeking general freight rate increases, voluntarily lower freight rates between points along the inland waterways system. For instance, in an effort to recapture Mexican lead cargoes from the canal, the railroads published a rate making it cheaper to ship lead from Mexico to St. Louis than to relatively nearby inland points.[29] The Inter-state Commerce Laws will not allow the railroads to lower their rates below those of the waterways.

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[28] Inland Waterway-Facts and Figures, op. cit., p. 40.

[29] George Sessions Perry, "How You Can Sail through Texas," The Saturday Evening Post, July 15, 1950, p. 27.

Recreational Facilities

The recreational facilities of this area have increased greatly and can be attributed directly and indirectly to the Intracoastal Waterway.

Fishing, one of the most popular sports in America, has a large attendance along the Intracoastal Waterway. Padre Island, 125 miles long, offers some of the best surf fishing in the United States. There are numerous projects being planned and built for recreational facilities on this island at the present time and eventually will bring to the area thousands of tourist dollars, especially during the winter season.

On the Intracoastal Waterway thousands of fish escape the winter storms in the sheltered waters of the canal making it a paradise for the many sportsmen. In transversing the area from Corpus Christi to Freeport, Texas, the fishermen can expect to find in the waterway or the shallow lagoons nearby, numerous species of fish such as: redfish, trout, flounder, whiting, drum, pike, mackerel, pan fish, and tarpon, with the predominant fish being the fighting trout and redfish.

Many chartered sports-fishing boats ply this area and provide a livelihood for many people who live in the Waterway's hinterland.

Thousands of small pleasure craft use this waterway throughout the year as it shelters them from the many quick and sudden squalls on the Gulf of Mexico.

Many "Bait and Boats," docks supply fishermen and sportsmen along the Intracoastal canal and immediate area. A map titled "Fishgide," published by the Gulf Oil Corporation, gives the location and time of year for the different species of fish to be found in the lagoons, Intra - coastal waterway, bays, and Gulf of Mexico. This map indicates that

there are 33 "Bait and Boats" establishments on the Intracoastal Waterway proper between Corpus Christi and Galveston, Texas. This classification of "Bait and Boats" includes not only one establishment, handling boats, bait, and fisherman supplies, but sometimes as many as five. There are 60 such "Bait and Boats" points between Corpus Christi and Galveston, Texas. This map also furnishes depth of water and is sometimes conveniently used as a navigation aid although not recommended by the Gulf Oil Corporation.

For the sportsman who does not wish to use boats there are many piers and bridges from which he can fish, and oftentimes with better results than the fisherman who uses the best boat and equipment.

During the writer's field study he saw many types of pleasure boats on this waterway. Some of these types are: (1) Sailing schooners, (2) converted yachts from navy surplus, (3) cruisers of various sizes, 20 to 75 feet in length, (4) small "Class" sailing boats from 12 to 21 feet in length, (5) charter fishing boats, ranging from 32 to 70 feet in size.

To illustrate how thousands of dollars may be brought into this area by the tourist, the following two examples are cited: (1) most of the fishing boats charter for 25 to 40 dollars a day and are kept very busy, (2) the sailing schooners (50 feet in length) charter for 50 dollars a day or 300 dollars per week.

The Canal Hinterland

The area transversed by the canal is one of the richest in the world.[30] Its resources are undergoing only their initial exploitation. Noted authorities state, for instance, that more wealth is taken from the ground within a 200-mile radius of Houston than from any area of equivalent size anywhere in the world. Industrial as well as total construction in this area in 1946 and 1947 exceeded that of any other area in the United States, both in total dollar value and percentage-wise.[31] The world's most extensive example of industrialization in a subtropical region is the area along the Gulf Coast. It includes the world's largest tin smelter (Texas City), rice-packing plant, rice mill and the nation's largest oil refinery (Bay Town, Texas), the large Dow Chemical Company, extracting magnesium from salt water. The 25-mile Houston Ship Channel has the greatest concentration of newly built industry in all the world, a One Billion Dollar investment.[32] When expansion (1949) that is under way has been completed, the Gulf Coast will have 85 per cent of U. S. capacity to brew chemicals from petroleum hydrocarbons.[33]

Today the Gulf Embayment Province is one of the world's richest petroleum reservoirs.[34] The chief sources of Gulf Coast oil are those

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[30]Colonel Henry Hutchings, Jr., "Progress Report," Proceedings 43rd Annual Convention Intracoastal Canal Association, (Beaumont, Texas: Intracoastal Canal Association, 1948), p. 8.

[31]Ibid., p. 8.

[32]"The Golden Coast," op. cit., p. 84.

[33]Ibid., p. 86.

[34]Frederick Simpich, "How We Use the Gulf of Mexico," The National Geographic, January, 1944, p. 14.

geological formations, the "salt domes." They are huge underground upthrusts of solid salt, extending thousands of feet through the ground as though punched up by some giant thumb.

Conclusion

In this chapter the writer has mentioned some of the many industries and their products, located on or near the canal.

Chemical industry is strung along the Houston Ship Canal. The world's first synthetic glycerine plant, a large industrial alcohol plant, a $14,500,000 plant producing chlorine and caustic soda, a $1,5000,000 phosphoric acid and phosphate plant, a large production unit for the making of ammonium sulphate for fertilizer, all of these industries are located in the Texas City area close to Galveston, and is considered to become in the near future the plastic center of the world.[35]

The five large refineries in Corpus Christi shipped 2,522,405 barrels of petroleum into Corpus Christi via the Intracoastal during the first nine months of 1948 and shipped out of Corpus Christi on the canal some 9,730,000 barrels of petroleum products, or a total trade of 12,252,405 barrels of petroleum products.[36]

The service rendered by inland waterway transportation during World War II demonstrated conclusively that it is a vital instrument of national defense; that it is a permanent integral part of our national transportation structure; and that there is an inescapable national need for all forms of transportation. Truly this region becoming highly industrialized ranks as another of America's great manufacturing frontiers.

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[35] Herman and Joellyn Muellec, "Southwest's Industrial Highway," The Christian Science Monitor, November 12, 1949, p. 5.

[36] Byrd Harris, "Corpus Christi," Proceedings 43rd Annual Convention Intracoastal Canal Association, p. 15.

CHAPTER VI

FUTURE OF THE TEXAS INTRACOASTAL WATERWAY

The United States is developing more resources and building industries in locations of which it has never before dreamed which makes it imperative that its waterways develop and expand simultaneously. It is indisputable that certain freight, naturally transported on waterways, can be moved at costs not approached by any other system.

The phenomenal advancement occurring in inland waterway transportation augur well for the future. Today on the inland waterways more powerful and faster towboats and larger and more efficient barges enhance their transportation value. Fast and efficient integrated tows of barges for handling of petroleum and petroleum products, automobiles and other commodities, have made their appearance and offer great possibilities for betterservice. Radar and other electronic devices for safer navigation are rapidly becoming standard equipment. All of these accomplishments necessitate heavy investments of private capital and form the incentive for even greater improvements in the future.

The public becomes increasingly aware of the importance of water transportation. Because of its accessability to many shipping areas, its convenience and adaptability for many bulk cargoes, as well as cheaper unit costs, inland water transportation will assume even a more prominent place in our National transportation picture.

Constantly conducted research is being actively prosecuted to develop new types of equipment, new propulsive methods, improve navigation, and find means for handling cargo more efficiently and safely. All of these developments will enable inland waterway transportation to retain a large volume of traffic as well as to attract additional patronage.

The quest for lower transportation costs will induce many industries to locate here, as demonstrated in the past two decades. Due to the threat of high-powered bombs, no longer can the majority of large industries be safely centralized, as in the New England district, the Chicago and Detroit areas and the few centers on the west coast. They must be scattered where they will be safe to produce the vast quantities of materials for an all-out war effort, but near to their source of supply of raw materials such as those mentioned. This provides a great saving to the industries in peace time making for better production and economy for the nation.

Inland waterway transportation is efficient, safe, reliable and performs an important function in the economy of the United States. Competition among the different media of transportation permit shippers, receivers and consumers an unrestricted choice of the type of transportation required, at fair and reasonable rates. The vital necessity of inland waterway transportation to the security and defense of the Nation is beyond dispute. Inland waterway transportation has come to stay and will create a better mode of transport for the future, an indispensable asset to the Nation and its progress.

The writer, after studying this area and realizing the great potentialities of the Intracoastal Waterway as it transverses this rich region, can readily see the direct way in which benefits will occur, not only to the Texas Gulf Coast Region, but also to the United States as a whole. Such benefits would include: (1) An efficient means of transportation, (2) an inducement for industry to locate in the area, (3) provision for employment for many people living near the canal, (4) promotion of recreational facilities, that will bring in untold remunerative returns to this area, and (5) awareness of the nation to the realization that water transportation is not antiquated as often thought, but with its modern scientific methods and improvements, ranks as one of the essential industries of today.

APPENDIX

APPENDIX

It became apparent to the writer, after careful research and field study, that there was not enough available material concerning the listing of industries located on the canal or close by the waterway who use this media of transportation. After writing all of the Chamber of Commerce offices in the cities located on the waterway, from Beaumont to Corpus Christi, Texas, and further correspondence with Mr. John W. Fulbright, President of the Intracoastal Canal Association of Louisiana and Texas, and his associates, for this information, it was decided a questionnaire should be sent to the industries located in the cities on this waterway.

A selection of the industries was made by the writer from a publication of "Texas Industries--Location and Products," in: Beaumont, Port Arthur, Port Neches, Port Bolivar, Galveston, Freeport, Matagorda, Port O'Connor, Rockport, Aransas Pass, Port Aransas, Port Lavaca, Palacios, and Corpus Christi, Texas.

Ninety questionnaires were sent out and sixty-five were returned. An analysis of the returned questionnaires was made and is shown in Tables VII and VIII by type companies.

APPENDIX A

STUDENT'S LETTER

615 West 3rd
Stillwater, Oklahoma
January 1, 1952

Mr. John Doe, Traffic Manager
Dow Chemical Company
Freeport, Texas

Dear Sir:

I am writing you for information concerning the Intracoastal Canal, its operation, tows, cargoes, etc. This information is needed for the thesis which I am writing for my Master's degree in geography here at Oklahoma A.& M. College, Stillwater.

The thesis covers the area from Corpus Christi to Beaumont, but an overall picture of the entire waterway is also needed. It is believed that this survey of the Waterway is the first of its kind to be made. A copy of the thesis will be sent to the U. S. Army Engineers, Galveston, Texas, for their files.

Will you please answer the enclosed questionnaire which I am sending you and several other companies operating on this waterway. A self-addressed stamped envelope is enclosed for your convenience in returning this questionnaire to me.

If your company publishes a brochure or pamphlet not only concerning the relationship of your plant to this mode of transportation, but also your plant's complete operation, a copy would be greatly appreciated. I am interested in illustrated material and if you have any photos showing your location to the canal and if they are available I would appreciate them (airplane views, types of ships used, tanker, cargo and relationship of the plant to the waterway).

Thank you for your cooperation in this matter.

Sincerely,

Thomas F. Pace
615 West 3rd
Stillwater, Oklahoma

APPENDIX B

QUESTIONNAIRE

INTRACOASTAL WATERWAY

1. a) What types of cargo are shipped by your company? _____

   b) In what form (bulk, raw, finished, etc.) _____

2. What is the origin of the raw materials used in your industry? _____

3. What are your destinations of the finished product shipped by waterway _____

4. a) Is the Intracoastal Waterway your primary source of transportation? _____ (Yes or No)
   b) Approximately what per cent of your cargo (including raw materials used in your industry) is shipped by:

      (1) Waterway _____
      (2) Railroads _____
      (3) Truck _____

5. Did the cheaper rates afforded by the Intracoastal influence your company's decision in locating at your present site? _____ (yes or No)

6. When did your company locate at its present site? _____

7. Approximately when did you first use the Intracoastal Waterway? _____

8. Do you operate your own ships, tugs, or barges? ____ (Yes or No)

   a) If so, approximately what per cent of your personnel are employed in the operation of those vessels? _____
   b) Does your company maintain and repair these vessels or is the job subleted? _____
   c) If not, how large a fleet do you charter on the average? _____
   d) How large is your fleet of boats? _____

9. a) What is the annual estimated value of finished cargo shipped by your company on the Intracoastal Waterway? _____

   b) What is the estimated value of raw materials coming in via Intracoastal Waterway to your company? _____

10. Do climatic factors interfere to any great extent with your shipments via waterway? That is, rain, wind, and humidity, storms, etc. _____

11. Do climatic factors such as humidity in the summer time affect the efficiency of your personnel? _____

12. Is your equipment affected by rust or other elements as a result of being located close to salt water? _____

13. Are there any other factors relating to the Intracoastal Waterway that would be of significance to this study: such as economy problems, climatic and physiographic problems, or perhaps the future growth of the Intracoastal Waterway? _____

BIBLIOGRAPHY

BOOKS AND ATLASES

Atwood, Wallace W. The Physiographic Provinces of North America. New York: Ginn and Company, 1940.

Blair, Thomas A. Climatology. New York: Prentice-Hall, Inc., 1942.

Commercial and Marketing Guide, Chicago: Rand McNally and Company, 1946.

Evans, Everett F. and Donahue, Roy L. Our South--Its Resources and Their Use. Austin: Steck Company, 1949.

McLaughlin, Glenn E. and Robock, Stefan. Why Industry Moves South. Kingsport: Kingsport Press, Inc., 1949.

Ward, Robert DeC. Climate. Boston: Ginn and Company, 1925.

_____. The Climates of the United States. Boston: The Athenaum Press, 1925.

Ward, Robert DeC. and Brooks, Charles F. The Climates of North America. Berlin: Verlag von Gerbruder Borntraeger, 1936.

White, C. Langdon and Foscue, Edwin J. Regional Geography of Anglo-America. New York: Prentice-Hall, Inc., 1943.

World Oil Atlas. Houston: Gulf Publishing Company, 1948.

Zimmerman, Erich W. World Resources and Industries. New York: Harper and Brothers, 1951.

GOVERNMENT PUBLICATIONS

Annual Report of the Smithsonian Institution. Natural Waterways in the United States, Report. W. W. Harts. Washington: Government Printing Office, 1917.

Corps of Engineers, U. S. Army. The Gulf Intracoastal Waterway: 1950. Bulletin SWNVI 000.7. Washington: Government Printing Office, 1950.

Department of the Army, Corps of Engineers. The Intracoastal Waterway: January, 1948. Gulf Section, Part II. Washington: Government Printing Office, January, 1948.

U. S. Army, Corps of Engineers. Annual Report of the Chief of Engineers: 1948. Report. Vol. I, Part I. Washington: Government Printing Office, 1948.

U. S. Army, Corps of Engineers. Navigation Maps of Intracoastal Waterway: 1950. Maps, Gulf Section. Washington: Government Printing Office, 1950.

U. S. Army, Corps of Engineers. Navigation Maps of Intracoastal Waterway: June, 1951. Maps, Gulf Section. Washington: Government Printing Office, 1951.

U. S. Bureau of Weather. Airway Meteorological Atlas for the United States: 1948. Washington: Government Printing Office, 1948.

U. S. Corps of Engineers, Department of the Army. The Gulf Intracoastal Waterway: November 1949. Washington: Government Printing Office, November, 1949.

U. S. Corps of Engineers, Department of the Army. Transportation Lines on the Atlantic, Gulf and Pacific Coast: 1951. Series V. Washington: Government Printing Office, 1951.

U. S. Department of Agriculture. Yearbook of Agriculture: 1941. Climate and Man. Washington: Government Printing Office, 1941.

U. S. Department of Commerce. Climatological Data: 1942. Washington: Government Printing Office, 1942.

U. S. Department of Commerce. Climatological Data: 1947. Texas Section, Vol. LII. Washington: Government Printing Office, 1947.

PERIODICALS

Barton, Donald C. "Voltaic Coastal Plain of Southwestern Texas." Geological Society of America, XLI (1930), 359.

Brown, Andrew H. "Man Against the Hurricane." National Geographic Magazine, October, 1950, pp. 537-560.

Chambers, William T. "Shopping Areas of Texas." Texas Geographic Magazine, Autumn, 1949, pp. 17-23.

______. "Geographic Regions of Texas." Texas Geographic Magazine, Spring, 1940, pp. 7-15.

"Corpus Christi." Monthly Business Review, XXXVI, No. 8, October 1, 1951.

Cunningham, William A. "Mineral Resources of Texas." Texas Geographic Magazine, Autumn, 1946, pp. 18-28.

Jones, Louis J. "Industrialization of the Texas Gulf Coast Region." The Southwestern Social Science Quarterly, June, 1950, pp. 1-16.

Kildroth, [illegible], Jr. "Weather Factor and Offshore Operations." The Petroleum Engineer, July, 1952, pp. 84-91.

Moe, Lawrence [illegible] and Self, Huber. "The Magnesium Industry." Economic Geography, October, 1949, pp. 296-313.

[illegible] and [illegible]. "Southwest's Industrial Highway." The Christian Science Monitor, Magazine Section, November 12, 1949.

Perry, George Sessions. "[illegible] Texas." The Saturday Evening Post, July 15, 1950, [illegible].

______. "Beaumont-Port Arthur-Orange." The Saturday Evening Post, November 17, 1951, pp. 27, 166-171.

Richards, Horace G. "Marine Pleistocene of Texas." Bulletin: Geological Society of America, Vol. L, December 1, 1939, p. 1699.

Schoch, E. P. "Mineral Resources of Texas." Texas Geographic Magazine, Autumn, 1941, pp. 19-30.

Walker, Willis [illegible]. "The Influence of the Shore Lines and Rivers of Texas." Texas Geographic Magazine, Autumn, 1940, pp. 26-31.

Simpich, Frederick. "How We Use the Gulf of Mexico." National Geographic Magazine, January, 1951, pp. 1-40.

PAMPHLETS

Bethlehem at Beaumont. Bethlehem Steel Company, Shipbuilding Division. Beaumont, Texas, Booklet 287 (1950).

Corpus Christi Manufacturers and Fabricators. Chamber of Commerce, Corpus Christi, Texas, (1951).

Harrington, Lare. "Beaumont Ced Plans for Post War Opportunities," The Beaumont Committee for Economic Development. Beaumont, Texas,(1944).

Inland Waterway Transportation in America. The American Waterways Operators, Inc., Washington, D. C., (1948).

Inland Waterways--Facts and Figures. The American Waterways Operators, Inc., Washington, D. C., (1950).

Luster, Ronnie. "Fishgide." Gulf Oil Corporation. Houston, Texas, (1950).

Padre Island. Padre Island Development Company. Corpus Christi, Texas, (1950).

Padre Island News. Fort Printing Company. Corpus Christi, Texas, (June, 1951).

Port Neches Works. The Texas Company. Port Neches, Texas, (October 16, 1949).

Proceedings. Intracoastal Canal Association. Houston, Texas, (November 21-22, 1948).

Proceedings. Intracoastal Canal Association. Houston, Texas, (November 25-26, 1951).

"The Flowing Road," The Lamp. Standard Oil Company, New York: N. Y. Vol. 33, No. 1, (March, 1951).

The Humble Way. Humble Oil and Refining Company. Houston, Texas, Vol. VI, No. 6, (March-April, 1951).

NEWSPAPERS

N. O. Gulf Canal Is Asked in Bill. The Times Picayune. New Orleans, Louisiana, (August 19, 1951).

Smith, Harriett. "Geographic Influences in the Settlement of Black Prairie in Texas." Journal of Geography, XIX, November, 1920, pp. 288-294.

Stephenson, Lloyd W. "Major Marine Transgressions and Regressions and Structural Features of the Gulf Coastal Plain." American Journal of Science, XVI October, 1928, pp. 281-298.

"The Big Gamble." Fortune, July, 1948, pp. 68-71.

"The Golden Coast." Fortune, Volume XL, October, 1949, pp. 83-95.

"The Last Link." Time, June 27, 1949, pp. 80-82.

Thornwaite, Warren C. "The Climates of North America According to a New Classification." Geographical Review, XXI, 1931, pp. 633-655.

Twichell, Trigg. "Water-Texas Presumed Natural Resource." Texas Geographic, Spring, 1947, pp. 8-11.

BIBLIOGRAPHY

Carruthers, L. L. Field Representative, The American Petroleum Operators, Inc., New Orleans, Louisiana (January 25, 1952).

Morgan, Bruce F. Manager, Chamber of Commerce, Corpus Christi, Texas, (February 10, 1952).

Robinson, F. G. Traffic Manager, Galveston Chamber of Commerce, Galveston, Texas, (February 25, 1952).

Roney, James P. Traffic Manager, Port of Corpus Christi, Corpus Christi, Texas, (February 21, 1952).

Vickers, Lyle. Vice-President, Port Arthur Chamber of Commerce, Port Arthur, Texas, (February 16, 1952).

Waskell, Paul T. Traffic Manager, Chamber of Commerce. Houston, Texas, (February 19, 1952).

Baker, L. H. Vice-President, Intracoastal Canal Association, Port Arthur, Texas, (February 23, 1952).

Woods, L. H. Secretary-Treasurer, Delong Enterprise Corporation, New Orleans, Louisiana, (January 5, 1952).

Moore, F. G. Traffic Manager, Columbia-Southern Chemical Corporation, Pittsburgh, Pennsylvania, (April 30, 1952).

Bradbury, Philip G. Manager, Public Relations, The Texas Company, New York, New York, (April 14, 1952).

Gillot, E. J. Asst. to General Manager, Lutcher Steel Company, Beaumont, Texas, (April 2, 1952).

Schorlemer, F. C. Superintendent, The Texas Company, Port Neches, Texas, (March 31, 1952).

Rogerson, L. E. Administration Superintendent, Freeport Sulphur Company, Freeport, Texas, (April 3, 1952).

Peacock, J. Bruce. M. Chapo Rice Milling Company, El Campo, Texas, (April 1, 1952).

Myer, Levis, Jr. Administrative Assistant, The Atlantic Refining Company, Philadelphia, Pennsylvania, (April 16, 1952).

Featherston, Hazel. The McClancey Company, Beaumont, Texas, (April 15, 1952).

Boddie, William W. Director of Public Relations, The Dow Chemical Company, Freeport, Texas, (April 17, 1952).

Birdwell, J. D. President, Gulf Manufacturing and Lumber Company, Beaumont, Texas, (April 3, 1952).

Vermilyea, Victor. Purchasing Agent and Traffic Manager, La Gloria Corporation, Corpus Christi, Texas, (April 3, 1952).

Harber, Ray C. Superintendent, International Creosoting and Construction Company, Beaumont, Texas, (April 2, 1952).

Strawn, L. R. Plant Manager, Jefferson Chemical Company, Inc., Port Neches, Texas, (April 1, 1952).

Daugherty, J. C. District Manager, United States Steel Products, Port Arthur, Texas, (April 11, 1952).

Rultman, S. J. Works Manager, Columbia-Southern Chemical Corporation, Corpus Christi, Texas, (April 14, 1952).

Smylie, Vernon G. Public Relations Director, Point Comfort Works, Aluminum Company of America, Port Lavaca, Texas, (April 11, 1952).

Teegerstrom, H. L. United Carbon Company, Inc., Shamrock, Texas, April 3, 1952).

Doyle, Gerry. Beaumont Rice Mills, Beaumont, Texas, (April 3, 1952).

PERSONAL INTERVIEW

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Title of Study: The Intracoastal Waterway, Beaumont to Corpus Christi, Texas

Number of Pages in Study: 72 plus vii

Under Direction of What Department: Geography

Scope of Study: This study was undertaken to determine the importance of this Industrial Highway, in the development of the present industries located near the canal and the facilities new industries would have when moving into the area, also the varied commodities carried by waterway and types of commercial and pleasure craft using the waterway. Data were obtained from government publications, periodicals, company publications, books, personal interviews and correspondence. The heart of the study is the Economic Aspects and its relationship to the entire Gulf Coast region.

Findings and Conclusions: The Gulf Intracoastal Waterway was one of the last modes of transportation to develop in this area. Today it is one of Texas's leading highways for bulk cargo such as: petroleum and petroleum products, lead, zinc, sulphur, cotton, liquid and dry chemicals and sand. The climate is suitable for year-round operation and the canal serves as protection for the many small craft from the sudden thunder storms and line squalls in the summer months on the Gulf of Mexico. This climate is classified as humid-mesothermal--precipitation adequate at all seasons and is very comfortable in which to live. The canal is located on the Fringe of the Gulf Coastal Plain and passes through a flat featureless deltaic coastal plain whose elevation is almost sea level. Nature's building off-shore bars, Padre and Mustang Islands, affords a natural protection for this waterway. The Intracoastal was constructed by the U.S. Army, Corps of Engineers and is maintained by them. The estimated cost of maintenance for this section, including the area from Corpus Christi to Brownsville, Texas, is one million dollars annually. Radar and other scientific improvements for navigation are becoming standard equipment on the many small vessels. New designed barges make up integrated tows. The new tugs are faster, more efficient, thus a saving to the many shippers. From the analysis of the returned questionnaire the reasons for many of the industries moving or locating in this area was because of the ready access to many raw materials, cheaper transportation costs, plentiful labor supply and a favorable climate. The public is becoming increasingly aware of the importance of inland waterway transportation. The benefits of this waterway come not only to Texas, but also to the nation itself. Over one billion dollars has been invested along this canal at Texas City, Texas, and many predict that this area will be the plastic center of the world.

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