RECENT GEOLOGY AND GEOMORPHIC EISTORY OF CENTRAL COASTAL LOUISIANA

A Thesis

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Louisiana State University and
Agricultural and Mechanical College

In Partial Fulfillment
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in:

The Department of Geology

by .

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B.S., Michigan State College, 1950
M.S., Louisiana State University, 1953
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Ye marshes, how candid and simple and nothing-withholding and free Ye publish yourselves to the sky and offer yourselves to the sea!

The Marshes of Olynn. IV. 6 Sidney Lanier (1842-1881)

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tion with an investigation of "Trafficability and Navigability of Louisiana Coastal Marshes," a study conducted by the School of Geology at Louisiana State University under the auspices of the Office of Naval Research, Contract N7 onr 35608, Task Order NR 088 002. The survey was conducted during a period extending from June, 1951 to January, 1954. Approximately thirteen menths were spent in the field collecting date; the remaining menths were devoted to organization of material and library research while enrolled at Louisiana State University. Several short field trips were also made during the academic intervals.

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ABSTRACT

During the Quaternary great changes have occurred in coastal Louisiana. The processes giving rise to these changes are still operative today. Such modifications are reflected in the sediments laid down during any given time span. In this study an attempt is made, primarily through the interpretation of the sedimentary record, to roughly outline the history of central coastal Louisiana during the preceding 150,000 years. Emphasis is placed on the changes of the last 5,000 years.

An omnipresent factor in the interpretation of the history of central coastal Louisiana is the shifting position of the ancestral Mississippi River. After studying the characteristics and deposits of the present Mississippi, it is possible to assign ancient sediments to positions relative to the previously existing major streams. Thus borings are of great importance in determining ancient environments and the then existing coastal configurations. A cultural chronology, based on Indian artifacts, has proven very helpful in establishing the relative ages of various streams. In addition, surficial evidence, as indicated on aerial photographs, is often of value in determining the mode of origin of various surfaces, establishing the relative ages of streams, and in tracing old stream courses. A combination

of borehole information, cultural evidence, and surficial expression thus enables a fairly complete picture of ancient conditions and changes to be drawn.

Deep borings indicate that entrenchment of the Gulf Coast streams, and subsequent refilling of the troughs, has occurred twice within the last 150,000 years. This entrenchment and refilling was a result of major fluctuations in sea level caused by expansion and contraction of polar ice sheets. Shallow borings, cultural evidence, and surficial expression makes it possible to decipher much of the complex physiographic history of central coastal Louisiana since the filling of the most recent trenches. In addition, similar evidence plus the position of former beaches makes it possible to formulate a sequence of Mississippi River delta shifts during the last 2,500 years.

It is hoped that the methods used in interpreting the history of this region will find application in similar deltaic areas throughout the world.

INTRODUCTION

This investigation is primarily concerned with the history of sedimentation, and the resulting physiographic expressions and characteristics, of a portion of coastal louisiana.

In a study of this type accurate maps and charts are of the utmost importance. Department of Engineer Quadrangles, United States Geological Survey sheets of 1935, United States Coast and Geodetic Survey charts, and aerial photographs of the area (flown during April and May of 1951) were extensively employed. Hand-auger borings, stream profiles, level lines, etc., were accurately located on aerial photographs (scale of 1:23,600) while in the field. Later these locations were transferred to office copies of Department of Engineer Quadrangles or United States Geological Survey sheets. A separate file card was then prepared for each bore-hole (approximately 300 in the area) or profile; numbered, and filed according to quadrangle location. Field notes were transcribed and revised to form a relatively coherent and chronological record of the investigation. Aerial photographs (flown in the spring of 1953) at a scale of 1:40,000 were used in the construction of several extensive mosaics. Aerial obliques flown during the spring of 1952 facilitated location of such shoreline features as oyster reefs and mudflats. Comparison of old charts with

recent maps indicated many interesting changes in shoreline position; size of islands; width of bayous; depths of lakes, bays, and bayous; and areal extent of various water bodies.

Boats were essential in most field operations. A fourteen-foot wooden skiff powered by an outboard motor was used extensively. The skiff, easily launched by two men, was transported on a small boat trailer pulled by a jeep or carryall. On numerous occasions a thirty-seven foot, shallow draft (3-3 1/2 feet) cabin cruiser was employed. A small boat was still needed, however, as many water bodies were too shoal to allow navigation with the larger boat. Some bayous, canals and lakes could be navigated only in a pirogue. Walking across the marsh, while not pleasant, is possible and in many cases necessary.

High, firm ground was traversed in a jeep or carryall.

Many firm tracts, not accessible by road, were reached by
boat and examined on foot or horseback. Marsh buggles and
helicopters are ideal for marsh work; however, their extremely high rental fees were irreconcilable with the project
budget.

Drilling equipment consisted of a specially designed bit (Morgan and McIntire, ?), several four and eight foot lengths of three-quarter inch galvanized steel pipe (threaded at both ends), numerous pipe sleeves (used to connect the sections), and two or three eighteen inch pipe wrenches. The

bit was fabricated by welding a 1 1/2 inch ship auger (about eighteen inches in length) to a 2 1/2 foot length of three-quarter inch galvanized pipe which was threaded at the opposite end. Grinding produced a more desireable bevel and a finer cutting edge which facilitated drilling in shell. This auger has proven superior, in most respects, to the post-hole or bucket-type auger previously used in marsh work.

By rotating the pipe with the wrenches until approximately one foot of hole was made, a good core was usually obtained. Difficulty in extracting the pipe was experienced if coring was attempted for more than a foot and one-half at one In fact, when drilling in firm, highly tenaceous clays it is not advisable to make more than one-half or three-quarters of a foot of hole per insertion. Sample recovery was not good in sand or shell; however, the driller can "feel" these materials when encountered in the hole. Probing (simply pushing the auger down) through fairly soft homogeneous layers and coring the firm zones proved satisfactory in many cases. Samples were examined in the field and notes were taken regarding the approximate plasticity, grain size, water content, degree of compaction, organic content, color, and degree of oxidation. A small hand lens was very helpful in making the examinations. On the basis of these observations the depositional environment of the sample could often be determined. Ecological studies of the macro- and

micro-fauna of the coastal region would be extremely helpful in this phase of the work as certain faunal assemblages should characterize definite environments and conditions. A definite attempt should be made to utilize micro-paleontology more fully in any further projects concerning deltaic regions.

Equipment was available for sounding bayous and water bodies, taking bottom samples, running level lines, and measuring salinity. Soundings were made with a weighted leadline. An ordinary, long handled, kitchen pot firmly secured to an eight foot wooden pole proved to be a very effective bottom sampler. A clam-shell type dredge was utilized in obtaining bottom samples in deeper water. A dumpy level was employed in running elevations and determining distances across relatively firm ground. The trembling character of the marsh, however, reduced the accuracy of a tripod mounted level as any nearby movement would disturb the "set." Therefore, a hand level was essential, and sufficiently precise, for most marsh work. Occasionally salinity readings were taken with salinity hydrometers, but fragile equipment of this type never survived many field trips.

Had additional funds been available a few obstacles could have been alleviated or eliminated. One difficulty faced throughout the project, was the lack of equipment capable of drilling relatively deep (100 feet) holes. The need was acutely felt in high, firm areas where even a thirty foot

hand auger hole was a herculean and time consuming task.

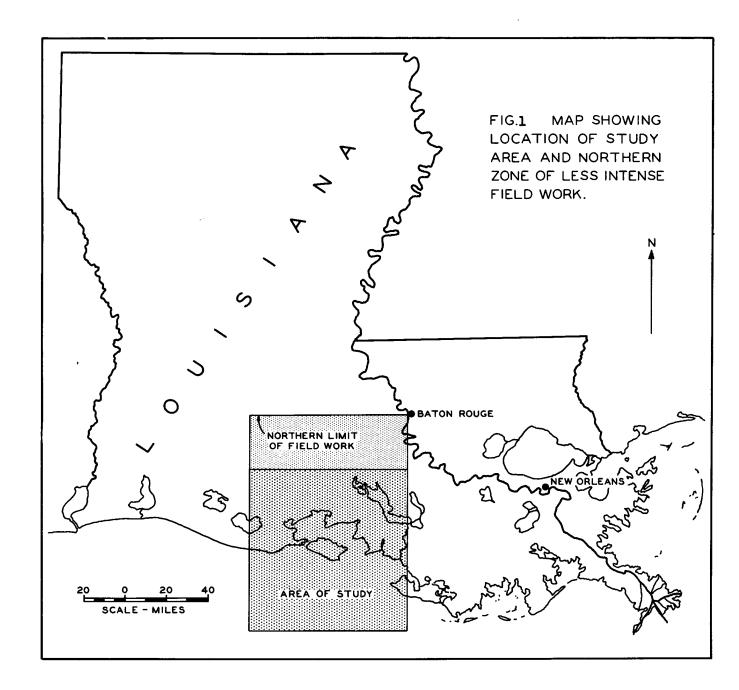
Current velocity meters could have been utilized and the empirical data collected applied to theories concerning tidal channel formation and flow, closing of crevasse channels and other related problems. As previously pointed out, an ecological study made concurrently with the investigation would have been of tremendous value. Fortunately, funds were available for the running of over 150 grain-size analyses. The majority of these analyses were of beach materials, and will probably be incorporated in a technical report dealing with the beaches of Louisiana.

AREA INVESTIGATED

Location and Climate

The area covered in this report extends westward from the Atchafalaya River (91 degrees, 15 minutes west longitude) to the vicinity of White Lake (approximately 92 degrees, 30 minutes west longitude), and is roughly bounded on the north by the 30 degrees, 5 minute north parallel of latitude (Fig. 1). Some field work was necessary as far north as 30° 25° north latitude, however. The area investigated, embracing approximately 3,000 square miles, includes the parishes of Iberia and St. Mary, the greater part of Vermilion Parish, and portions of Lafayette and St. Martin Parishes. tillable land comprises approximately one-quarter of this area or about 750 square miles. The remainder consists of marshes, swamps, and water bodies of various dimensions. To a Louisianian, contrary to widespread belief and accepted dictionary definitions, marsh and swamp are not synonymous. As Russell (1936, pp. 24-25) has previously pointed out, a marsh is a saturated region supporting grasses, sedges, rushes, and similar vegetation, rather than trees. To deserve the designation of swamp the dominant growth of a watery area must be arborous.

Its subtropical latitude and proximity to the Gulf of



Mexico are the two most important factors in determining the climate of this region. January average temperature in this zone is 53.9 degrees Fahrenheit; that of July, 81.8 degrees. The number of frost free days averages 270 per year. The marine tropical influence is obvious when one considers that the average water temperatures of the Gulf along its northern shore ranges from 64 degrees Fahrenheit in February to 84 degrees in August.

In summer the prevailing southerly winds provide a moist, tropical climate. The average annual precipitation is 57.86 inches and of this amount approximately 62 per cent falls in the interval extending from April through September. July and August are the wettest months with average monthly precipitation of 8.08 and 6.05 inches respectively. Much of this precipitation is in the form of afternoon thundershowers which occur almost daily during certain periods of the summer months. However, when the pressure distribution is altered so as to bring westerly or northerly winds, periods of hotter and drier weather occur in the usually moist summer.

In the colder season the region is alternately subjected to tropical air and colder continental air, in periods of varying lengths. Though warmed by its southward journey, the cold occasionally brings large and rather sudden drops in temperature. Relatively cold, southward flowing water upon reaching the warmer waters of the Gulf helps produce the fog

though the records for southwest Louisiana are far from complete, it appears that January and February are the foggiest months. In an area such as coastal Louisiana where shorelines stretch hundreds of miles at an elevation of less than five feet above sea level, and where ten feet of relief is not found within 25 or 50 miles of the coast, a low lying haze can be very troublesome.

Although this region seldom experiences storms of a large cyclonic character, it is occasionally visited by winter storms which usually approach from the north or northwest. Local storms of small area have occurred in all seasons, but show somewhat more frequency in spring. Now and then, usually during September or October, a hurricane will destroy large portions of the low lying, easily eroded marshlands. A three year period rarely passes without the visitation of one of these awe-inspiring storms along the Louisiana coast.

While admitting the climate is relatively enjoyable, the writer, nevertheless, believes that Mr. T. W. Poole (1891, p. 10) was carried away with artistry when he stated, "Well might one dilate at large on the large, lucious, innocent, soothing narcotism of gulf airs, but space forbids." Needless to say, Mr. Poole was employed by the state of Louisiana as Immigration Commissioner at the time the above

literary gem was penned.

History

The region embracing the parishes of Iberia, Lafayette, St. Mary, St. Martin, and Vermilion, was formerly known as the Attakapas² district or country. A name derived from a tribe of Indians, supposedly cannibalistic, who once occupied this region. Colorful accounts of their eating habits are found in the literature. Perrin (1891, p. 247) states that their favorite repast was a stew consisting of the clam Rangia and Homo sapiens! However, the Choctaw, Alabamon, and the Opelousas tribes united and nearly annihilated the Attakapas in a great battle, fought on a hill about four miles west of the present site of St. Martinville. This massacre occurred before the white settlers came into the country, and by 1803 approximately 100 individuals, scattered throughout the district, were all that remained of the once powerful Attakapas (Sibley, 1803, p. 24).

The first reports of the area came from the Spanish

I This section was compiled mainly from works by Jriffen (1936), Carter (1952), Darton (1933), and the St. Martin Development Board (1950).

This word appears in the literature as Attakapas, Attakapas, Attakapas, and Atacapas. Attakapas is the spelling most generally used and the form used in this report.

missionaries of los Adaes. Some of the missionaries began making frequent visits to the Attakapas tribe, thus indicating that the anthropophagous tendencies of the Attakapas were probably greatly exaggerated. These Spanish visitations, however, did not result in the founding of missions, as was usually the case with their early explorers, and not until the French had established a trading center did the white man's influence begin to manifest itself in the area.

The first considerable influx of settlers began soon after 1760. Previous to this time there were scattered over the Attakapas region a few trappers, traders and ranchers. This impetus to colonization was provided by the English expulsion of the Acadians from Nova Scotia in 1755-56. While scattered among the English settlements along the Atlantic coast, these exiles were not content to be absorbed into the hated English population and naturally turned their faces toward Louisiana where lived their kinsmen. Although the vast territory of Louisiana was officially transferred to Spain in 1763, the government made numerous grants of land in Attakapas district to exiled Acadians between 1760 and 1770. Nevertheless, according to a census taken by Governor O'Reilly, in 1769 the total population of the entire district was only 409. France regained Louisiana through the Treaty of San Ildefonso in 1801, but did not officially take possession until November 30, 1803. At this time the number of

inhabitants in the Attakapas district had reached 3,746, of which 1,266 were slaves (Sibley, 1803, p. 20). Sibley also states that a considerable portion of the populace was American. The United States purchased Louisiana on April 30, 1803 and formally took possession on December 20 of the same year.

In 1805 Attakapas County or Parish was created, embracing a land area of approximately 3,500 square miles. The name was changed to St. Martin Parish in 1807, but this designation did not replace the earlier appellation in the vernacular. St. Mary Parish was fashioned from a portion of St. Martin Parish in 1811, as was Lafayette Parish in 1823. With the creation of Vermilion Parish in 1844 and Iberia Parish in 1868 the present parish boundaries were established. The population increased steadily throughout this period and by 1950 had reached 196,224 (combined total population of St. Martin, St. Mary, Lafayette, Vermilion, and Iberia Parishes).

St. Martinsville, known as Poste des Attakapas during the Spanish regime, is the oldest settlement in the region.

Aside from the Acadian immigrants, the early residents included many officers of noble French and Spanish families who

³ The above dates should be borne in mind when doing research on this area. For example, information concerning all five of the present parishes can be found in early accounts of St. Martin and St. Mary Parishes.

⁴ All localities, within the project area, mentioned in the text can be found on Fig. 2.

remained here after their appointments had expired. St. Martinsville for many years was the center of considerable culture and at one time served as a summer resort for New Orleans society. The region is perhaps most popularly known from Longfellow's narrative poem of the fair Acadian "Evangeline," the scene of which is laid principally in the Attakapas region. At St. Martinsville under the "Evangeline Oak," in the yard of the church constructed in 1765, is the heroine's grave. Here too is the Longfellow-Evangeline State Fark and Museum where various souvenirs of her life are on exhibition. Southwest Louisiana still has an Acadian (since corrupted to "Cajun" by the local inhabitants) population, dialect and atmosphere and these, together with its ancient structures and legends, make it a very interesting place to visit.

Agriculture and Natural Resources

Gently rolling, grass covered prairies are one of the great attractions of this region. Grazing of cattle and horses was the main activity of the early settlers. Even today cattle, in great numbers, are grazed throughout the area, not only on the prairie lands, but in the marsh as well. Marsh herds of a special breed, requiring little care while in pasture, must be transported (usually by barges) to high

⁵ Although supposedly based on fact, Longfellow took many liberties with the original story.

land before the summer months, as cattle lose weight rapidly when under continued attack by swarms of summer mosquitos. In some cases the animals have been killed by these insects. Their deaths, however, were brought about not by being eaten "on the hoof," but rather by suffocation due to sealing of the cranial openings by clouds of mosquitos.

Early attempts at agriculture were made by the Spaniards. About 1765 the Spanish government sent a colony from the Canary Islands to engage in the cultivation of flax and hemp (Mann, 1912, p. 6). This enterprise proved a failure, but indigo was raised successfully and became a staple commodity. Some cotton was also produced, but by 1812 sugar cane was becoming increasingly important (Stoddard, 1812, p. 182). Today sugar cane is the leading crop with about 91,500 acres in cultivation. This acreage produced 1,596,251 tons of cane in 1948. Of this total Iberia Parish contributed 575,083 tons; closely followed by St. Mary Parish with 547,235 tons (Landry, 1952, p. 378). Recently rice has become an extremely important crop in the southwestern portion of the area. Rice completely dominates the agricultural picture in Vermilion Parish today.

Trapping, one of the earliest pursuits followed in the region, continues to play a prominent role. Muskrat, nutria, mink, raccoon and other fur bearing animals are found in the coastal marshes. The prodigious numbers of muskrat enables

Louisiana to produce more commercial pelts than any other state in the Union. The nutria (South American coypu—

Myocastor coypu) was accidentally introduced into the Iberia

Parish marshlands in 1937. Previous to this time there were

no nutria in the Louisiana marshes. These prolific animals

have multiplied so rapidly that the Louisiana nutria take for

the 1948-49 season was 26,738. Many people believe these

rodents will become one of the most valuable fur producers

on the North American continent.

The waters of the region abound in edible fish and shellfish. Some shrimp are taken throughout the year, but the heaviest catches are made in the late summer and fall. The shellfish industry has made remarkable progress, especially in the last thirty years, from the inauspicious beginnings of the 1880's to the million dollar business of today. Patterson and vicinity is an important shrimp landing region, contributing the greater part of the 11,997,930 pounds of shrimp brought into St. Mary Parish in 1948. Almost the entire catch is taken by small otter-trawl boats which drag bag-like nets along the bottom. Today the best shrimping waters are found off Cameron and Vermilion Parishes. The lack of deep navigable waterways opening directly into the

⁶ This early fishing was confined to the inland water bodies. Shrimping in the Gulf did not realize any great importance until the 1930's.

Gulf and the present size of the shrimping fleet are factors which will probably forestall any great expansion of this fishery in the region. The blue crab is found abundantly in the bays and bayous; however, the lack of large nearby markets for fresh crab has been an important factor in holding back the development of this fishery. Twenty years ago oysters flourished along the shoreline, and in the inland waters of the region. Artificial drainage canals (for the Atchafalaya Basin) and the Atchafalaya River have brought increasing amounts of fresh water and sediment into the area. Influx of sediment has almost destroyed the oyster reefs and threatens to extend destruction farther westward.

Within the last forty years substantial oil production has been achieved. St. Mary Farish alone produced over 11,200,000 barrels of petroleum in 1948, and the combined total production of the five parishes was approximately 34 million barrels. The oil usually occurs in association with intrusive salt masses called salt domes (see Physiography Section). Some of the shallowest domes are mined and Iberia Parish has three of the largest producing salt mines in the world.

Oil activity has brought about a noteworthy increase in population. The city of Lafayette, for example, increased in size by seventy-four per cent between 1940 and 1950 due mainly to the petroleum industry.

A few of the natural resources have been ruthlessly exploited. In this category fall the lumbering and alligator enterprises. The extensive tracts of cypress and live oak, which made the area a lumbering bonanza in the late 1800's and early 1900's, have been cut. Small saw mills still operate in Vermilion and one or two other parishes, but the colorful lumbering days are of the past. Alligators once infested the swamps and marshes. Early accounts tell of hordes of the pugnacious reptiles completely closing fairly large bayous, thus making navigation impossible (Cathcart, 1819). Animals eighteen or twenty feet long were not rare in these early days and ten foot gators were common. Their decline is evident when one considers that the alligator "take" for Louisiana in the 1948-49 season was 35,796, and only thirty-five of these animals were over ten feet in length. However, prohibiting alligator hunting on several state refuges has brought about a reversal of this depopulation in a few scattered regions.

The future prosperity of this region seems to depend upon oil, sugar, rice, and trapping. Exploration for oil is in progress in all of the five parishes and many new fields will undoubtedly be discovered. Sugar cane is the most important agricultural commodity, especially in the eastern parishes, and there seems to be little tendency for transference of acreage to other crops. Rice is well established

in the southwestern sector and will probably grow in importance if irrigation problems can be overcome. A great deal of water is pumped from the Vermilion River during the late summer months for irrigation purposes, often giving rise to the intrusion of a sult water wedge, which sometimes extends upstream to the vicinity of Abbeville. At certain points this salt water invades the graveliferous aquifers from which other irrigation water is pumped. As rice cannot tolerate brackish water, results of these conditions can easily be disastrous. Studies are being made by the Louisiana Geological Survey in an effort to alleviate the situation, but until a solution can be affected the rice acreage in this section cannot be greatly increased. Trapping seasons seem to run in cycles with years of high fur production followed by periods in which the catch is very disappointing. However, there seems to be no overall trend toward a decrease in the number of fur bearing amimals. Application of conservational practices will enable this activity to perpetuate its position as an important source of revenue for the region.

Although few manufacturing companies have located here, there is a definite trend toward industrial infiltration. Lafayette, Franklin, and New Iberia appear as probable centers for industrial growth. Another potential source of revenue, which is by no means overlooked either in this region or Louisiana as a whole, is the tourist. The "Cajuns"

of southwest Louisiana are a colorful and interesting people; their lands, which are famous in history and legend, abound in fish and wild game of many varieties. Wild geese and ducks in prodigious numbers winter in the marshes, truly making the region a hunter's paradise. Many points of interest in both the historic and aesthetic sense are found here. These attractions and their proximity to New Orleans should provide the expedients to lure a greater portion of the tourist trade into the area.

HIYSIOGRAPHY

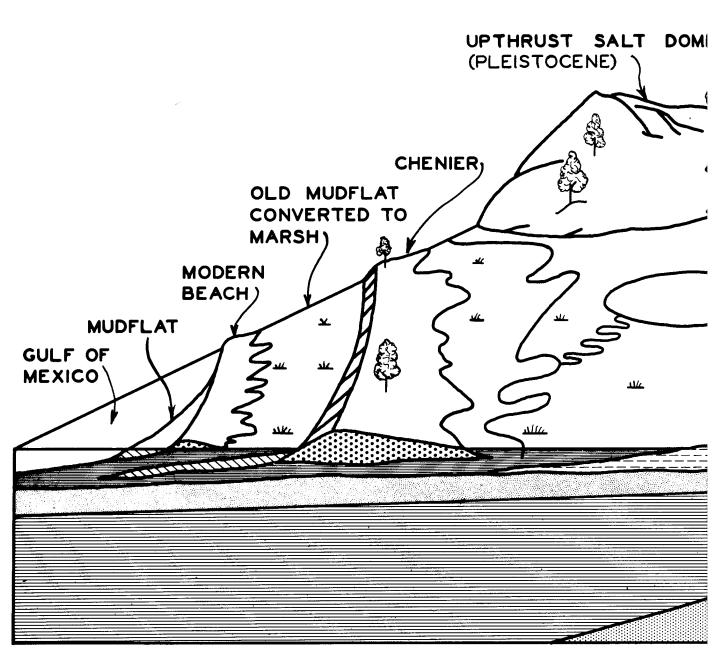
Although the writer has tried, in the preceding pages, to present a brief, cultural picture of the area more or less divorced from physiographical aspects, the reader has undoubtably sensed the controlling influence of physiography on the cultural, agricultural and economic patterns of the region. The following paragraphs, therefore, will present a fairly detailed description of the major physiographic regions and features found here.

Figure 3 is a representation of marshland physiography and its sedimentary relationships. In this block diagram many physiographic features have been crowded into a small area; however, it should be realized that most of the marshland appears as a level, seemingly endless, water and grass plain, with very few, if any, relief features breaking the monotony. A physiographic map of Central Coastal Louisiana is presented as Figure 4.

Prairie Terrace

Firm, arable land is found on the Prairie Terrace, along the crests of natural levees, and on a few existing and stranded beach ridges. The Prairie Terrace, so named by

DIAGRAMMATIC ILLUSTRATION OF AND COASTAL !





I. BEACH DEPOSITS 3. MUDFLAT DEPOSITS 5.





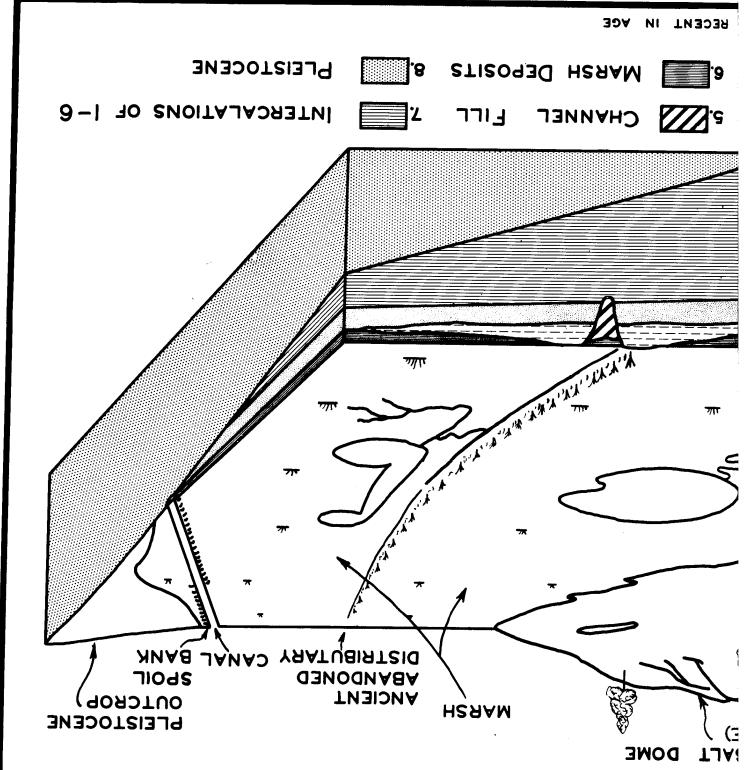
LEVEE DEPOSITS

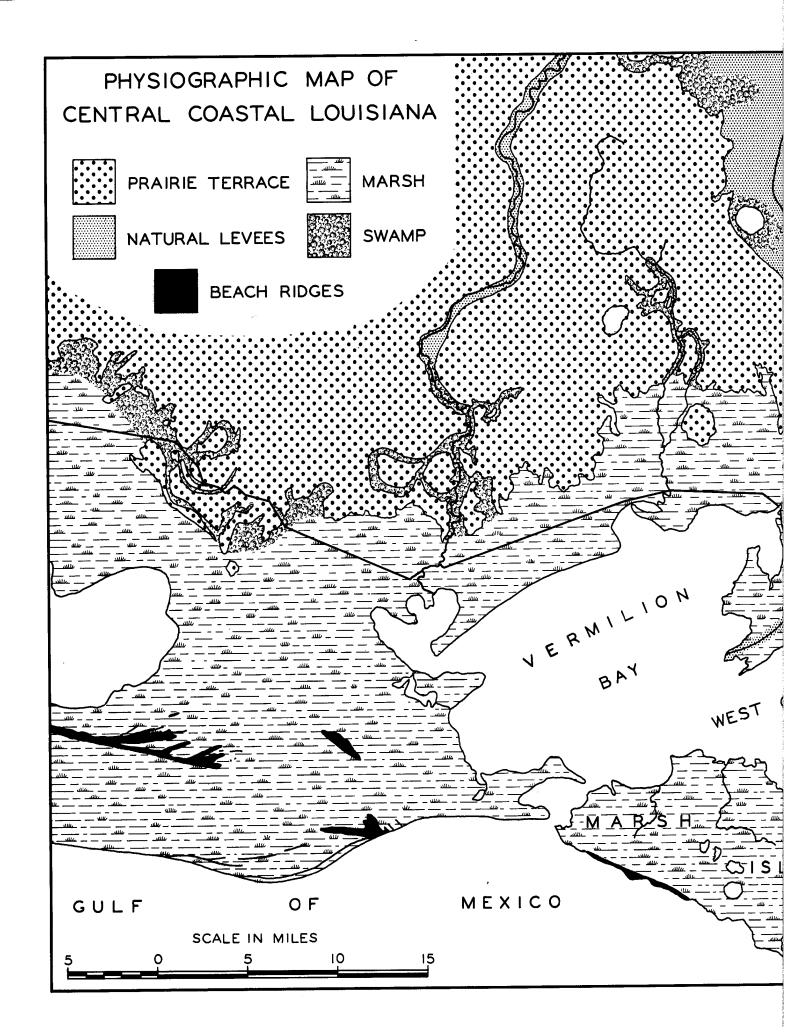


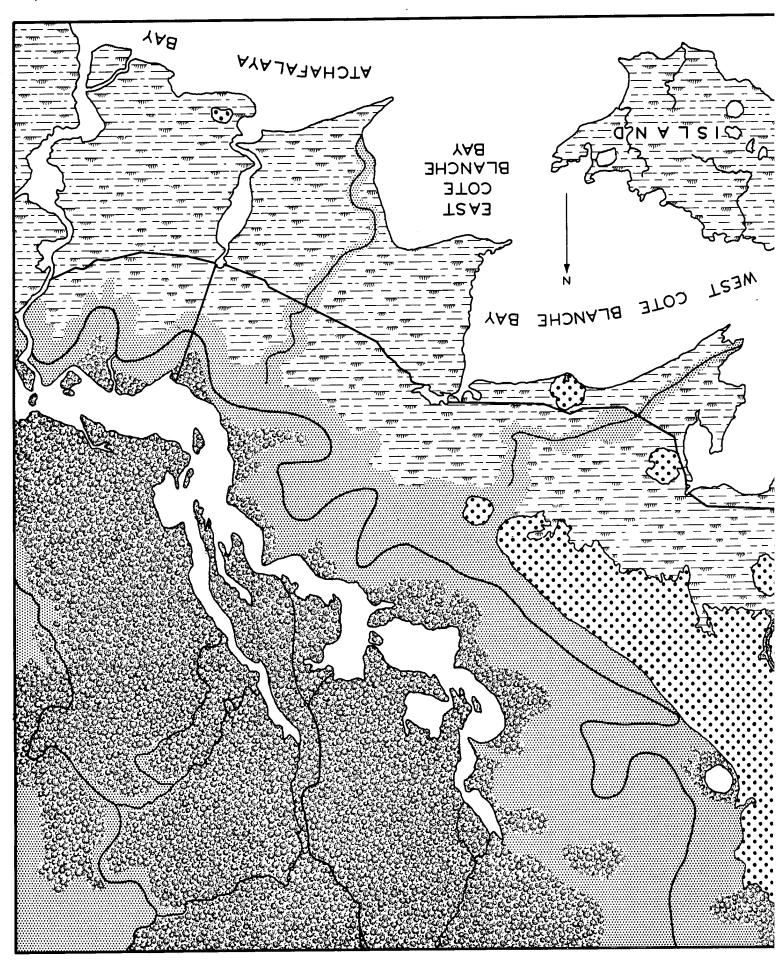
BAY & LAKE DEPOSITS



N OF MARSHLAND PHYSIOGRAPHY STAL SEDIMENTS







Fisk (1938), is the remnant of a huge Fleistocene deltaio plain that reached its maximum areal extent in this region approximately 50,000 years ago. The genesis of this surface will be treated in the Geologic History section of this report. A wedge of Frairie (Fig. 4) constitutes the largest tract of solid ground in the region. This undulating surface rises from an elevation of two feet (MGL) at its southern contact with the marsh, which strikes roughly N-W, to height of nearly thirty feet near Rayne and Lafayette (Fig. 2). The main axis of the deltaic mass plunges gently S-SOV through the Lafayette area, thus originally giving rise to a slight E-ESE and a similar western slope away from the axial elevations. Eastward, the Prairie Terrace disappears beneath the Recent sediments near Baldwin. In general, the Prairie dips very gently Gulfward (one and one-half to two feet per mile) and has a maximum relief of about twenty-five feet. northeastern border of this plain has been scalloped by a Recent course of the Mississippi River, resulting in a scarp that increases in elevation northward. The relief shown by this scarp is negligible south of Jeanerette; ten feet near New Iberia, and twenty-five feet at Lafayette.

⁷ The interval extending from one million to 25,000-15,000 years ago.

⁸ The interval extending from 25,000-15,000 years ago to the present time.

Moresi (1933, pp. 13-15) who consider this scarp to be postPleistocene in origin. The cuspate border of the scarp near
Lafayette certainly suggests lateral planation by a postPleistocene Mississippi River. The writer is aware that this
interpretation does not agree with Kesselli's (1941) concepts
of slope retreat. Kesselli deduces that it is impossible for
a meandering stream to planate laterally against cliffs much
higher than the normal natural levess. Field evidence certainly does not support this contention. The only possible
alternate explanation for the existence of this cuspate
scarp is to assume that it was cut by a late Fleistocene
stream that continued to meander for a long period of time
after entrenchment. This hypothesis seems highly improbable.

The undulations present on the Frairie Terrace are reflections of Pleistocene stream deposits. The channels, now filled and often discontinuous, of these ancient streams still find expression in the ponds and low swampy areas which dot the region. Most of these ponds, called "Marais" by the local inhabitants, are circular in outline. Russell has suggested that these circular depressions are a result of the compaction of sediments that filled the scour pools (local deeps in a channel usually at the outside of bends) of the buried river channels (Jones, 1954, p. 79). Although the Frairie itself is treeless the more poorly drained regions

often support stands of Drummond red maple, green ash, water oak, winged elm, red gum, willow oak, swamp blackgum, and baldcypress (Brown, 1945, p. 10) (Table I). The type of growth present depends to a large extent upon the length of time these depressions hold water. The impervious nature of the clay to clay-silt topstratum is the most important factor in letermining the treeless character of most of the region.

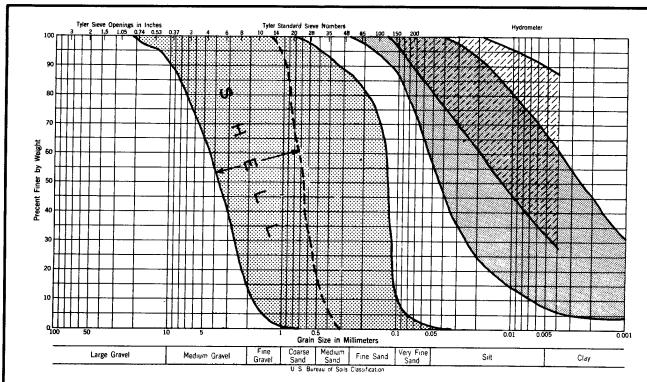
ent streams and on ridges where the land is better drained. The growth here consists of water oak, cherrybark oak, post oak, green ash, American elm, red gum, shagbark hickory, cow oak, hawthorns and loblolly pine (Table I). Thus the timber found in this region occurs on land which is either better drained or more poorly drained than the Frairie proper (Brown, 1945, p. 10).

The exposed upper portion of the Prairie is well oxidized, commonly consisting of yellowish brown clays and silts (Fig. 5a). The sediments are rich in calcium, and many calcareous concretions are found at and near the surface. The light color of this uppermost zone stands in marked contrast to the darker hues of the marsh and swamplands which flank the Frairie Terrace in this region. This color contrast (Fig. 6) plus the arcuste patterns of Pleistocene meander loops, which cover portions of the Frairie Terrace, are distinctive criteria for recognition of this surface on

		Sarg.	\neg	T	\neg	ří	\prod	T	$\overline{\top}$	T	T	T	T		T		1	$\overline{}$	T	-
TABLE I	1	1 1				Sarg.														
VEGETATION TYPES OF CENTRAL COASTAL LOUISIANA	Hooker & Arnold	biflora (Walt.)				var. lanceolata			, Koch.	7.								1	lia L.	
COMPILED MAINLY FROM BROWN (1936, 1944, & 1945) AND O'NEIL (1949)	Acer drummondii F	871	phellos L.	distichum Rich	ta Michx.	ल	styraciflua L.	nigra L.	ya ovata (Mill.)	Pinnus palustris Mill	1	Quercus pagoda Raf.	prinus L.	stellata Wang	- Ulmus americana L.		Quercus virginiana Mill.	farnesiana (L.) Willd	Baccharis halimifolia	Trr.
	Red maple -	ckgum - Nyssa	nercus pl	' '		1.	- Liquidambar st	oak - Quercus ni	ickory	if pine - Pinnus	pine - P	rk oak -	Juercus P	- Quercus	elm	m	- Quercus	- Acacia	1 tree - E	
		Swamp bl	. 5		Winged elm	Green ash	Redgum	Water o	Shagbar	Longleaf	Loblolly	Cherrybark	Cow oak	Post oak	American	Hawthorns	Live o		Groundsel	,
VEGETATION TYPICAL OF:	- -	1 8	3	m	3	U	2	3	0.	+	+	+	+	+	+	T	+	1		
DEPRESSIONS ON THE PRAIRIE SURFACE	_	丰	7	F	7	-		-	1	+	+		1	1	<u> </u>	1	1		+	-
BETTER DRAINED AREA ON THE PRAIRIE SURFACE	_	1	_	-	+			-	-	F	-	-	-	+	-		I	1	1	-
NATURAL LEVEES, SPOIL BANKS, & BEACH RIDGES IN FRESH MARSH AREAS		_	+	-	+	+	+	+	+-	+	+	+	+	+	+	-	-	I	1	-
NATURAL LEVEES, SPOIL BANKS, & BEACK RIDGES IN BRACKISH TO SALT MARSH AREA	72 1	1		+	+	+	+	\downarrow	+	+	+	+	+	+	+	+	+	+	+	-
FRESH WATER MARSH	_	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	,
BRACKISH WATER MARSH	_	_	_	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	٠
SALT WATER MARSH							\bot	\perp	\bot											•

Jointed saltwort - <u>Salicornia</u>	Joint
Salt water alligator weed - Philoxerus vermicularis	Salt
Salt-matrimony vine - Lycium carolinianum Walt.	Salt-
Black rush - Juncus roemerianus	Black
Sand rush - Fimbristylis castanea	Sand
Salt marsh grass - <u>Distichlis spicata</u>	Salt
Sea oxeye - <u>Borrichia frutescens</u>	Sea o
Saltwort - Batis maritima	Saltw
Couch grass - Spartina patens	Couch
Big cord grass - Spartina cynosuroides	Big c
Oyster grass - Spartina alterniflora	Oyste
Leafy three square - Scirpus robustus	Leafy
Three square - Scirpus olneyi	Three
Bayonet rush - Scirpus americana	Bayon
Cattail, broad leaf - Typha latifolia	Catta
Cattail, lance leaf - Typha angustifolia	Catta
Reed cane - Phragmites communis	Reed
Water millet - Zizaniopsis miliacea	Water
Bulrush - Scirpus validus	Bulru
Arrowhead - Sagittaria latifolia	Arrow
Paddle weed - Sagittaria lancifolia	Paddl
Pickeral weed - Pontederia cordata	Picke
Water hyacinth - Piaropus crassipes	Water
Paille fine - Panicum hemitomon	Paill
Sawgrass - Mariscus jamaicensis	Sawgr
Soft rush - Juncus effusus	Soft
Elephant's ear - Colocasia antiquorum	Eleph
Alligator weed - Alternanthera philoxeroides	Allig
Salt-matrimony vine - Lycium carolinianum Walt.	Salt-
Marsh elder - Iva frutescens L.	Marsi
Sand rush - Fimbristylis castanea	Sand
Sea oxeye - Borrichia frutescens	S e p
Tooth-ache tree - Zanthoxylum clava-herculis L.	Tooth
Black willow - Salix nigra	Black
Palmetto - Sabel minor	Palme
Cactus - Opuntia	Cactu
Hackberry - Celtis laevigata Willd.	Hack

Α

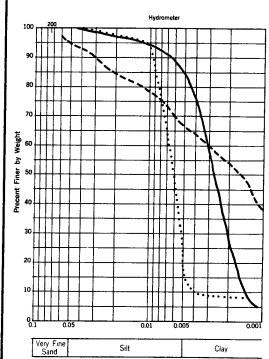


GRAIN SIZE RANGES OF GULF BEACH, PRAIRIE TERRACE, AND NATURAL LEVEE DEPOSITS

GULF BEACH
VERMILION AND IBERIA PARISHES
25 SAMPLES

PRAIRIE TERRACE
FROM FISK (1947)
40 SAMPLES

MISSISSIPPI RIVER NATURAL LEVEE
FROM FISK (1947)
90 SAMPLES



GRAIN SIZE ANALYSES - MUDFLAT SEDIMENTS

----- MUDFLAT MATERIAL (CHENIER AU TIGRE)

---- MUDFLAT MATERIAL (CHENIER LA CROIX)

В

GRAIN SIZE ANALYSES BOTTOM SEDIMENTS

---- SE CORNER ATCHAFALAYA BAY

GULF OF MEXICO - FLANKING SHELL KEYS

C

Figure 6 - Avery Island Region



aerial photographs.

To anyone familiar with manual drilling through Recent deposits into the Fleistocene, a discussion of how to recognize the contact will prove superfluous. Difference in color. oxidation, firmness, and water content are usually apparent. The Prairie topstratum is typically a stiff. gray to greenishgray, nodular (ferrugenous and/or calcareous), silty clay. Previous extreme oxidation gives rise to the mottled orangebrown and gray silty clays which frequently mark this con-The surface, underlying the Recent marsh, is moderately dissected and presents a good deal of subsurface relief. 9 Therefore, it would be naive to assume that the Prairie topstrutum is everywhere homogeneous and equally oxidized. fact, some holes show no oxidation in this upper zone. However, the difference in compactness and, hence, water content is obvious. The water content in the upper zone of the Frairie usually ranges from 20 to 30%, whereas, the darker, overlying Recent marsh deposits consistently show more than 32% (Fisk, 1948). The resulting difference in firmness is easily noticed when putting down a bore hole; indeed, the stiff, tenacious character of this zone effectively discourages deeper penetration with hand auger equipment.

⁹ The top of the Pleistocene is usually encountered within 100 feet of the present surface in the area considered in this report. Exceptions to this statement will be pointed out in the Geologic History section.

Salt Domes

With four noteworthy exceptions, there are no exposures of Prairie south of the line marking its gentle plunge beneath the Recent deposits. The exceptions constitute four of the famous "Five Islands" of Louisiana. 10 These remarkable elevated areas, caused by the intrusion of large masses of rock salt to within 100 or so feet of the present marsh surface, are found along a line bearing S49° E and running from Lake Piegneur to East Bay near the mouth of the Lower Atchafalaya River (Fig. 2). The elevations of the "Five Islands" range from forty to 130 feet above marsh level and in one case (Avery Island) the salt itself, capped by Pleistocene and possibly older material, is actually about fifteen feet above the present marsh surface. regions 130 feet of relief would be considered insignificant; however, hills of this elevation rising from a flat, featureless marsh appear spectacular indeed.

In outline the "islands" are usually more or less circular, the largest (Weeks) having a diameter of slightly more than two miles. Their surface topography is typically rugged and small fresh water ponds are found in the depressions.

Although of the same soil type as the flat lying Prairie

¹⁰ Jefferson Island rises from the Prairie Terrace itself between New Iberia and Abbeville.

to a heavy stand of large trees of a type found only under special conditions on the Prairie proper (Table I). On aerial photographs, due to this dense arborous cover, these "islands" appear as slightly darker, stippled, circles and ovals in the more even textured marsh. However, where man has cleared the timber the light colored, oxidized, silty clay of the Frairie stands in sharp contrast to the surrounding marsh (Fig. 6). Where crestal collapse of a shallow dome has occurred, due to solution of the underlying salt, the surficial expression is often that of a lake (e.g., Lake Peigneur).

Natural Levees

Natural levees, which flank most large streams, are deposits of flood waters crossing normal banks. They consist of the coarsest material, usually silt-size, carried in suspension by the stream. The high, firm, well drained crests of these levees were attractive strips for early settlement. Indians encamped on the ridges at a time when the volume of fresh water flow was great enough to sustain their numbers. When the flow became too feeble the village was gradually abandoned and new encampments were made near other sources of fresh water. Refuge heaps (middens) of these villages, consisting of clam shells (Rangia), pottery, and other artifacts,

are found along some of the streams. Early white settlement in the region was concentrated along the leves of the main artery of travel, Bayou Teche. Modern roads, where possible, are located to take advantage of the firm well drained land of the leves crest. Although the natural leves does not dominate the cultural pattern as completely as in the more eastern Louisiana marshes, they are, nevertheless, of great importance.

Typically, the distal portion of an active stream, where slight stage variations will inundate the low banks, will have low, grass covered levees. Slightly upstream, where the banks are higher and not continually flooded, willows and other woody plants are found. Farther upstream the well drained and spasmodically inundated levees support luxurious stands of live oak (Russell, 1936, p. 77).

When stream flow is reduced sufficiently (to a point where high stage water fails to overtop the banks) levee growth is halted. With further reduction in flow, channel deterioration and filing takes place rapidly. Channel fill usually consists of extremely soft, organic (wood fragments, etc.), blue-grey clay and a basal zone of coarser material (silt or sand) covering the old stream bottom. Compaction and regional subsidence combine to slowly lower the levee crests thus allowing the marsh to encroach upon their flanks. Many streams in the region (e.g., Bayou Teche, Cypremort,

and Sale') exhibit the effects of reduced flow and subsidence.

8

The higher, wider, natural levees usually are cleared for cultivation, and on aerial photographs these light, rectangle marked bands are easily identified where they wend their way across the darker marsh. Uncleared levees, with their verdant growth of live oak, appear as sinuous, stippled ribbons crossing the more even textured marsh (Fig. 7). When levee growth ceases, subsidence dominates and the marsh begins to encroach upon the levee flank, bringing death to the live oak of the lower lovels. As subsidence continues, this zone of extermination will work upward toward the levee crest, while the invading marsh effectively covers the decaying, fallen trunks in the lower zones. Therefore, it is possible that a discontinuous double line of oak trees crossing the marsh could represent a formerly very important stream, whereas, much wider bands of trees might identify a more recent, but less important channel.

The width of existing levees is, therefore, a function of the stage variation and size of the dejositing stream and the amount of compaction and subsidence that has taken place since deposition. Small streams form steep, narrow levees, whereas levees of larger streams are generally broad and gently sloping. In this area levee crests seldom rise more than fifteen feet above marsh level and in most cases the relief is less than ten feet.

Figure 7 - Natural Levees of Bayou Sale'



In time the levee crests may be completely engulfed by the marsh and all surficial evidence of their existence obliterated (Fig. 3). Sinuous lines, of a different shade than the marsh proper, in a few instances reflect submerged levee systems. However, bore hole verification is needed in such cases. The transition from marsh to levee is usually indicated by an abrupt change in the stiffness of the material through which one is drilling. This change is due mainly to the difference in water content between marsh and levee. The water content of levee deposits ranges from 15 to 25% which is, at the maximum value, 10% less than that of most marsh material. A levee sample typically consists of bluegray silty clay or silt (Fig. 5a) with varying concentrations of small, brown, oxidation nodules. The presence of oxidized nodules or zones is a basic criterion for the recognition of levee material in bore holes. Organic material, rarely present, usually occurs in small bands or layers and is not disseminated throughout the levee as it usually is in marsh deposits.

From the above description some similarity between levee and Prairie Terrace deposits is noted. This similarity is to be expected, for the same alluvial processes are operative today as produced the Prairie surface over 50,000 years ago. In bore holes the marsh covered Prairie surface can usually be distinguished from levee material by its greater

oxidation, more tenacious or "sticky" character, and the presence of carbonate nodules. In regions where old, well oxidized levee deposits overlap and flank the Prairie Terrace (e. g. between Jeanerette and Franklin) differentiation is more troublesome. As a consequence the outcrop pattern of the Pleistocene. in such areas, is difficult to determine. Several bore holes put down by the writer near Franklin showed no confirmation of Fisk's (1952, vol. 2, plate 13) "island" of Prairie in the surrounding levee deposits. Holes were drilled on the "island" and on definite levee material; no differentiation could be made. In the writer's opinion most of this area is underlain by levee deposits. The presense of a relict channel flanked by definite levees (not merely a trough) running across the "island" also supports this contention. Pleistocene is undoubtedly present at a shallow depth, and a smaller "island" than Fisk indicates may be existent. There are definite exposures of Prairie about three miles to the northwest. Fisk (1952, vol. 2, plate 12c) also fails to indicate the levess of Bayou Cypremort crossing the Prairie Terrace southeast of Jeanerette. These minor modifications of the Pleistocene outcrop pattern are presented in Fig. 4.

Beaches and Chemiers

Beaches of varying composition and height parallel some Gulf and bay shores in the region. In most cases,

marsh, lacking a superimposed beach, borders directly on the bays. Silt accumulations of small areal extent are found along the northwestern shores of Atchafalaya, West Cote Blanche, and Vermilion Bay. Most of these concentrations of silt are, in part, artificially produced. The man-made Wax Lake Outlet Channel, which drains a portion of the Atchafalaya Basin, supplies some of the silt sized particles found along the northwestern shore of Atchafalaya Bay. The upthrusting of the salt dome, Belle Isle, has also contributed to the sediment supply, not only through erosion products of the dome itself, but through a shoaling of the offshore profile, thereby intensifying the erosive and winnowing action of the waves.

Cote Blanche Island has been truncated by the retreating northern shoreline of West Cote Blanche Bay. At the point of truncation, wave attack has produced a cliff (an anomalous feature in marshlands) about fifty feet high.

Material eroded from the "island" has formed many localized silt-sand beaches, containing great concentrations of minute iron nodules, along the shore westward from the "island."

This westward drift is apparent in the bays, as along the Gulf shore, and is, in part, the result of the back eddies created by the dominant eastward current found in the northern portion of the Gulf of Mexico and the prevailing (southeasterly) wind direction.

1_

The northwestern shore of Vermilion Bay also exhibits several zones of silt concentration. The shallow depth of the Pleistocene (usually less than ten feet) and the dradging of the New Vermilion River Canal has influenced sedimentation in this area to a great extent.

Other types of beach deposits are found in the area. Small, localized, shell (predominately Ostrea and/or Rangia) beaches, superimposed on the marsh, are especially common along the northern coast of Marsh Island and the western shore of Vermilion Bay. The eastern shore of West Cote Blanche Bay is flanked by a blanket of black, organic flakes and particles, which reaches a thickness of two feet about 100 feet offshore. The texture and color of this material closely resembles, and is consequently called, "coffee grounds" by the local inhabitants (Fig. 8a). These accumulations are even greater along the eastern shore of Vermilion Bay, here forming small beaches and ridges, which, in many cases, almost completely close the mouths of small bayous discharging into the bay (Fig. 8b). This type of deposit is often found flanking the seaward edge of most beaches and is derived from decayed organic remains, of various vegetational types, which have been reworked and thrown there by wave ac-Concentrations as large as those found in sectors of West Cote Blanche and Vermilion Bay can only have their origin in the tremendous quantities of water hyacinth

(Piaropus crassipes) and alligator weed (Alternanthera philoxeroides) that annually choke the bayous entering these bays. From these sluggish bayous much of this fresh water floating vegetation finds its way into the brackish, deathedealing waters of the bay.

dom rise more than three and one-half feet above the mean water level of the bays. This figure includes the height of the marsh (usually less than one foot) projecting above mean water level. In other words, the relief (in reality the thickness) exhibited by these beaches rarely exceeds three feet. This is not the situation found along portions of the gulf coast where waves of a greater fetch and power form sand and shell beaches that frequently rise to heights of ten feet above mean gulf level.

The western coast of Marsh Island and the Chemier au Tigre area exhibit the most extensive beaches found in the region. Here hurricane waves carry beach material three quarters of a mile inland over beach crests that attain elevations of ten feet. Typically, washover deposits blanket the marsh for three or four hundred yards inland. The beaches usually present a rather steep gulfward side and a gentle landward slope.

The beaches in the Marsh Island-Chenier au Tigre region are composed primarily of sand and shell fragments



Figure 8a - Detail Photograph of "Coffee-Ground"

Material Flanking the Eastern Shore
of Vermilion Bay.



Figure 8b - Bayou Mouth Practically Closed by "Coffee-Ground" Accumulations - Eastern Shore of Vermilion Bay.

(Fig. 5a). Some of the coarsest sand found along the Louisiana coast is observed here. These deposits consist of reworked material brought in from offshore. Consequently, shells of animals characteristic of many different environments (e.g., marsh, deltaic, and marine) are found in beach deposits. The presence of numerous offshore oyster reefs explains the abundance of Ostrea fragments. The existence of other types of shells (e.g., Rangia, a typical brackish water form), and other data, suggests that the shoreline was at one time considerably south of its present position. Comparison of old and recent maps definitely shows that a landward movement of the shoreline has taken place, and is continuing to the west in Cameron Parish.

During the past fifty years, however, this landward advance of the beach has been halted in the Chenier au Tigre area, indeed, the shoreline is now moving gulfward. This reversal has been accelerated greatly within the last ten years, during which time, extensive mudflats have formed flanking the beach. The fluid clay, comprising the greater percentage of the deposits (Fig. 5b), is carried to the Gulf in suspension by streams and canals draining the Atchafalaya Basin. These small particles are carried westward from the Atchafalaya Bay region by longshore currents and deposited where coastal and bottom configuration dictates. Oyster reefs form effective sediment traps and wrest large quantities of suspended

material from the water. The influx of sediment laden fresh waters caused by the increasing discharge of the Atchafalaya River, has destroyed most of the oyster reefs in the area (Fig. 9a and b), and threatens to extend this devastation westward.

As the mud is deposited along the strand, and gradually increases in thickness to a point where normal high tide does not cover the surface with more than one or two inches of water, oyster grass (Spartina alterniflora) invades the newly formed zone. Within a year, after the critical height has been reached, this grass is found covering the mudflat in scattered clumps (See photographs Fig. 31). The vegetational cover aids in trapping sediment and soon the mudflat is converted into a marsh, which is inundated only during periods of strong southerly winds when water is raised to uncommon heights along this coast. One hurricane, however, can nullify the work of many years and destroy large portions of this low, newly formed land. Revertheless, the net effect is Gulfward advance. Consequently, as the mudflat expands seaward the former beach becomes separated from the Gulf by an evergrowing band of marsh.

Old, marsh surrounded, beaches (found up to nine miles inland) stand in mute testimony to previous fluctuations of the shoreline. These stranded beaches are called ridges, islands or chaniers depending, in part, on their size, and



Figure 9a - View Looking Shoreward from Tip of Oyster Reef off Chenier la Croix.

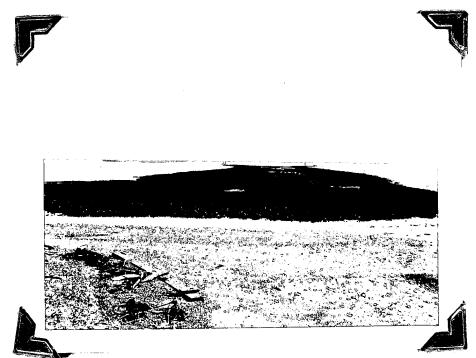


Figure 9b - Looking Gulfward along Reef Shown in Figure 9a. The Only Live Oysters Found Here Today Are Near the Gulfward Extremities of the Reef.

primarily upon the whims of local imhabitants. In Vermilion Parish the term ridge, when applied to a stranded beach, intimates a deposit of variable length, less than 250 feet wide, and with a maximum thickness of four feet. The terms island and chemier (used interchangeably in this parish) imply a greater width and thickness, but the variability in length persists. This classification does not apply in Cameron Parish; where "island" usually refers to small linear deposits and the appellation "ridge" is given to larger, thicker deposits. This terminology, although confusing and ambiguous, is well established in the vernacular and widely used on present maps. Therefore, the writer believes an inflexible definition of ridge, island, and chemier, as used in southwest Louisiana, would only lead to greater confusion and misunderstanding.

A good policy would be the application of chenier to all stranded beaches, regardless of size, and the elimination of the terms ridge and island, now often applied to such deposits. This would, however, entail considerable alteration of existing maps and, although a worthy suggestion, cannot be pursued too pedantically. In this report chenier is used to mean an old beach now stranded in the marsh. The word was also used in this sense by Howe and Russell (1935). This is not the accepted definition throughout coastal Louisiana. Russell (1939, p. 45) has pointed out that cheniers is used

in the southern part of the Mississippi Delta to mean any high ground and ordinarily refers to natural levees of abandoned channels.

Note should be taken of the fact that Chenier au Tigre and Chenier La Croix, as indicated on recent maps, are in part, beaches not entirely surrounded by marsh. However, the influx of sediment from the Atchafalaya region, giving rise to the rapidly growing mudflats, is swiftly making the appellations valid.

The chemiers derive their name from the heavy growth of oaks which often over them. As French is the language of the local inhabitants, the appellation is a natural one. Hackberry and cactus also flourish on the beaches and chemiers of the region (Table I).

Regional subsidence and compaction of the underlying sediments affect large beaches and chemiers to an even greater degree than natural levees. This is due to the greater weight of the sand-shell accumulations, and primarily to the properties of the type of deposit which usually underlies them (See Geologic History Section and Fig. 3). Project borings show slight compaction of sediments below chemiers and beaches with thicknesses of four feet. On larger deposits, it should be noted that the greatest downward bulge is not always directly below the beach or chemier crest, but is often found seaward of the crest. Thus, suggesting that a

previous beach crested seaward from the present one, and that the older beach has been completely destroyed by wave action, its detritus now comprising a large portion of the new beach formed a short distance inland. Fisk (1948, p. 23) makes note of this type of situation at Holly beach in Cameron Parish and also points out that Holly Beach has settled into the loosely consolidated Gulf bottom deposits of clays and silty clays by over two feet. Compaction and subsidence, of course, allow the marsh to encroach over stranded beaches (cheniers), and, in time, most surficial evidence of their presence is obliterated. The subsidence is much less rapid where the beach has been deposited directly upon a less compactable formation or ness a similar firm foundation near the surface—here slow regional subsidence dominates.

On aerial photographs, silt beaches appear as light, narrow, even textured, bands paralleling the bay shores. Often, if the photographs were taken at low tide, a similar irregular zone is found extending a few hundred feet offshore. Sand-shell beaches stand out as white lines along the water's edge. Washover areas present a more or less even textured, light colored or mottled appearance and contain few marsh lakes or ponds. This mottled effect is especially noticeable where the washover deposits vary considerably in thickness along the coast, thus allowing the underlying, darker marsh to find slight expression in some places.

Cheniers are discernable as light colored, lines and bands (in some cases separated by narrow breaks) arching across the marsh. If the chaniers or beaches are oak covered they exhibit a darker stippled texture on aerial photographs (Fig. 10).

Mudflats, while not revealed unless photographed at extreme low tide, often can be outlined by the narrow line of breakers which is usually noticeable at their gulfward edge (Fig. 10). In any event, the water covering the fluid clay of the shallow mudflat is much calmer and, therefore, presents a different texture on aerial photographs than waters gulfward of their limits. Nearshore oyster reefs stand out as short black lines. At mean tide the reefs are often delineated by narrow zones of breakers. Older reefs, farther offshore, are commonly swept clean of sediment and are thus revealed as white irregular lines. Photographs taken at high tide usually show little or no evidence of either the near shore or offshore reefs.

Buried or partially buried beach accumulations of sand and shell (chemiers) are, of course, easily recognized in bore holes. They comprise the coarsest deposits encountered in marshland work. Extremely compact, reworked, brownish-black, peat-like material is often found in thin wedges or pockets overlying the buried gulfward slope of chemiers. This thin layer represents the compacted residue of reworked

Figure 10 - Chenier au Tigre Region



organic remains ("coffee-ground" material) found along many of the present beaches. Mudflat clays, less organic and containing more shell fragments than typical marsh clays, directly overlie the gulfward margins of stranded beaches. Fisk (1948, p. 20) notes the absence of the clam Rangia, usually found in marsh and lake bottom deposits, from these mudflat sediments. Mudflat clays are, in turn, overlain by marsh deposits, which also overlap the landward edge of the chemier (Fig. 3).

Relatively thick (over five feet) sand and shell deposits are difficult to penetrate with the hand auger due to hole caving. However, if the chemier or beach can be pierced, a thin (three to six inch) layer of blue-greenish, slightly organic silt is usually encountered directly over the marsh deposits. This narrow band is undoubtedly the result of leaching of the overlying sand and shell by downward percolating waters. The presence of green carbonate nodules in this contact zone between the chemier and underlying marsh supports this contention. The presence of iron, in the reduced state, explains the green coloration of the nodules.

Marshlands

Marshes make up the greatest portion of the region's land area, forming, in some places, a monotonous, coastal band fifteen miles in width. The elevation of this flat,

featureless expanse of marshland seldom exceeds two or three feet (Mean Gulf -evel). Although their exact boundaries are not often determinable, the marshlands are usually divided into regions of fresh, brackish, and salt water marshes. It the gently dipping Prairie Terrace surface grades Gulfward into areas of fresh water marsh, which range from zero to five miles in width. Sawgrass, softrush, giant bullrush, and paille fine (Table I) are the dominant plants of the fresh water marsh. The transition zone between highland and marsh originally supported extensive growths of cypress. Ruthless lumbering operations, however, have long since destroyed these magnificent stands.

Brackish water marsh, the most extensive type, extends inland from the bay and gulf beaches for distances of five to ten miles. Bayonet rush, reed cane, cattail, oyster grass, and leafy three-square grass (Table I) are the dominant plants. As previously mentioned the demarkation between the major marsh types is flexible and not always apparent. This fact is easily understood when the extreme salinity variations, to which most inland water bodies and their borders are subjected, are considered. During times of storm large portions of the marshland may be inundated with saline water from the Gulf, while during flood periods much of the marsh may be covered

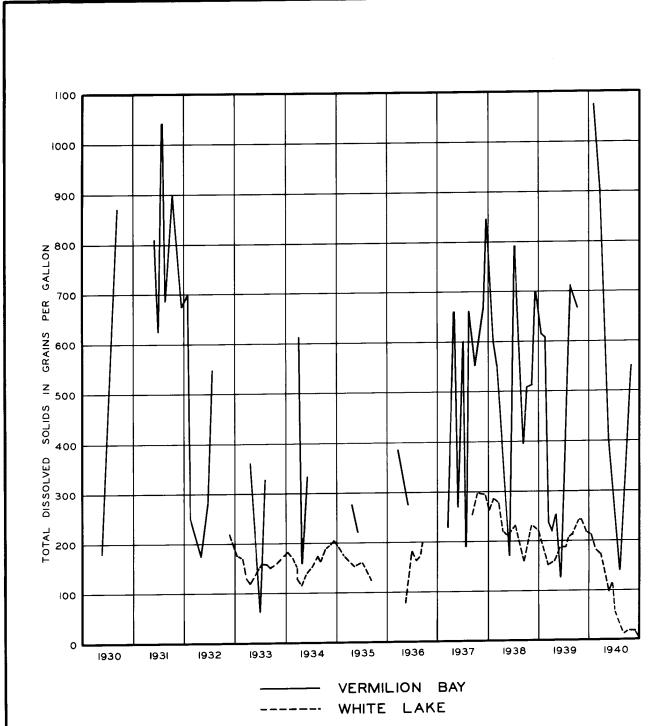
¹¹ O'Neil (1949) gives a more detailed breakdown and presents a map showing the vegetational types of the Louisiana marshes.

with relatively fresh water. Figure 11 shows the fluctuations in salinity over a ten year period in Vermilion Bay and White Lake. It will be interesting to notice the effect of the increasing influx of fresh water from the Atchafalaya region on the marsh vegetation of this region during the next few years.

In areas effectively drained by many tidal bayous and along the Gulf shore, stands of black rush, salt marsh grass, and needle cord grass (Table I) are found. These plants are typical of the salt water marsh.

The matural leves, Prairie Terrace remnants, chemiers, beaches, and spoil banks (dredged material thrown along the sides of artificially constructed canals) found throughout the marshlands support vegetation of a woody nature. Depending primarily upon drainage conditions and elevation, these features are crowned with growths of live oak, black willow, toothache tree, hackberry, hawthorn, marsh elder, groundsel tree, and salt matrimony vine (Table I).

not the same for different types of marsh. Although confined to very limited portions of this region (and therefore not included in the above classification of marshlands) the fresh water floating marsh (flotant) is the most difficult to traverse. Flotant (Russell, 1942) consists of a vegetational mat overlying a liquid, organic coze, which offers



GRAPH SHOWING FLUCTUATIONS IN SALINITY OVER A TEN YEAR PERIOD IN TYPICAL BRACKISH AND FRESH MARSH AREAS. (FROM O'NEIL 1949) areas of flotant are found in the coastal parishes to the east. It is found in this region north of Wax Lake in a discontinuous, southeast trending band about three miles in width, which extends for approximately twelve miles between Bayou Sale and the Lover Atchafalaya River (Fig. 2).

As Russell (1942, p. 79) has pointed out, saline waters tend to flocculate colloidal materials thus giving rise to relatively firm clays. Marshes in saline areas are therefore ordinarily underlain by firm clays and are more easily traversed than fresh water marsh. However, local sedimentation and subsurface conditions in some cases create exceptions to this principle. For example, areas of fresh water marsh forming a thin (five - six feet) covering over the firm Prairie Terrace surface are more trafficable than many regions of brackish water marsh. Incipient natural levees (e. g. along the Lower Atchafalaya River) represented by a two or three inch layer of silty clay, while not causing any great vegetational change, as yet, will nevertheless, increase trafficability in a narrow zone cutting across various marsh types. The latter example is, of course, a very shortlived situation, as further sedimentation will completely bury the existing flora and give rise to plants typical of higher ground. Therefore, although salt and brackish water marsh is usually more trafficable than fresh water marsh,

local conditions should be considered.

On aerial photographs marshes appear as even textured, featureless, expanses of various shades (Figs. 6 and 7).

This difference in shading, ranging from light gray to black, is dependent primarily upon vegetational differences and surficial water cover. During dry periods the upper peaty or organic horizon is often naturally ignited, resulting in extensive marsh burns. These burns appear as fan shaped, darker splotches on aerial photographs. The acute spices of these triangles, of course, point in the direction of the then prevailing wind. In addition, during the late summer many marsh areas are deliberately burned by trappers in an attempt to insure a constant annual food supply for the muskrat population of their trapping lands.

the highest water content of any of the various types of deltaic deposits. They are characteristically brown, bluegray, and gray-black. The color being determined, primarily, by the varying concentrations of organic material. Freshwater marsh sediments are usually soft and contain a high percentage of humus, resulting in a dark coloration; however, almost pure organic material when firmly compacted (peat) exhibits a brownish tint. Brackish and salt marsh sediments are firmer, less organic in composition, contain a higher percentage of clay or silty-clay, and are usually

blue-gray in color. The organic material present in brackish and salt marsh sediments is usually disseminated throughout as tiny flakes or particles.

Lakes and Bays

In a region, such as central coastal Louisiana, where the normal water table is usually less than two feet below marsh level, any small depression will naturally form a lake or ound. Although the original outline of such a depression may be elongate in any direction the outline, as the lake enlarges, tends to become circular. Local inhabitants claim that these round lakes originate as geese or muskrat "eat outs" or have their origin in march fires that effectively lower the ground surface by burning, not only the surficial vegetation, but the upper, highly organic, portion of the marsh as well. Russell (1936, p. 117) points out that both theories probably have some merit, but states that uncertain drainage appears to be a more common reason for their formation. He also observes that the vulnerable sites of origin are areas where organic material constitute a large percentage of marsh fill.

Lakes enlarge through wave erosion along their shores; therefore, it would be logical to assume that a water body would tend to elongate parallel to the prevailing wind direction. This assumption seems attractive in this region where

the prevailing winds are from the southeast and the maximum velocity winds usually approach from the northwest. Thus elongation in northwest-southeast direction seems mandatory. However, as previously pointed out, enlarging lakes tend to assume a circular outline. A possible explanation of this situation is offered by Russell (1936, p. 120) who states that "more erosion occurs in the marsh during one hurricane than during several decades of ordinary weather. When a hurricane is in progress, a point in the marshes not only may experience its most violent winds from any quarter but also will, in all probability, feel heavy winds from all."

The enlargement and coalescence of lakes with each other and other water bodies is extremely important in the formation of the larger bays. The synchronous enlargement of Little White Lake and the arm of Vermilion Bay into which Vermilion River empties, graphically illustrates the effect of coalescence of round lakes with other water bodies, thus giving rise to concevely arouate shorelines. U. S. C. and G. S. chart number 200 (1893) shows Little White Lake separated from Vermilion Bay by a narrow strip of marsh, which today has been completely eroded away. It is interesting to note that apparently the lake has enlarged mainly at the expense of its more easterly margins.

White Lake (west of Little White Lake - Fig. 2) is shown as two separate circular lakes on the General Land Office

Map of Louisiana (New Orleans, 1838) compiled by Catesby Graham. Although the map is unreliable as to distance and outline, the existence of two lakes in 1838 may be cautiously accepted. If Graham's map is accurate White Lake is one of the finest examples of round lake enlargement and coalescence to be found in the Louisiana marshlands.

largement progresses, physiographic features such as levees, beach ridges, and Prairie Terrace outcrops will delineate portions, if not all, of lake margins. Thus, in some cases, a lake may (1) originally exhibit an irregular or angular outline (possibly, in part, already controlled by physiographic features); (2) evolve to a more rounded or circular form; and (3) become modified, as physiographic features are intersected by enlargement and coalescence, to form a larger body of angular shape. The writer does not contend that all water bodies form in this sequence; however, examples of all the above mentioned stages of development can be found in the marsh lands.

Many small irregularly shaped lakes, representing the initial stage, are found along the northern shore of Vermilion Bay south of the Intracoastal Canal and scattered throughout the northwestern portion of Marsh Island (Fig. 2). Oyster Lake, on Marsh Island, is a good example of a more advanced stage in an area where no physiographic features are present

capable of modifying the circular enlargement. However, in the course of time, the concomitant retreat of the Gulf beach and enlargement of Cyster Lake will bring the beach into contact with the southern margin of the lake and modification of the circular outline will, of course, result. Bay Marchand and Bay Champagne, near the mouth of Bayou Lafourche in Lafourche Parish, have already experienced this type of truncation.

Vermilion Bay may be considered an example of a still more advanced stage. Originally the area presently occupied by the bay consisted of marsh dotted with small round lakes and several elongate lakes, formed in the levee flank depressions of the major stream flowing through the region (described in Geologic History section). Regional and local subsidence aided in the formation of more and more ponds, which were rapidly enlarged at the expense of the easily eroded marsh. In time, more subsidence enabled arms and extensions to the gulf to invade the region, even across physicgraphic barriers, and unite with the now extensive water bodies formed by the coalescene of the previously existing lakes and ponds. Mouths of streams (e.g., Vermilion River) entering the bay became drowned, thus forming expanding estuaries which engulfed more and more land. The unconsolidated. water laden, marsh material, of course, is more easily eroded than firm levee or Frairie Terrace deposits. Therefore, when

a physiographic barrier is encountered by an enlarging water body enlargement proceeds nore rapidly parallel to the feature, thus resulting in an elongate outline. Vermilion Bay today is more or less outlined by such barriers; however, these features cannot withstand the combined effects of subsidence and wave erosion and are gradually being eroded away. The natural levees of Bayou Cypremort, for example, at one time undoubtedly formed the southern margin of the bay but have since been destroyed by wave erosion of the encroaching waters.

Thus in all probability the extensive, enlarging water bodies of today were at one time, less than 1000 years ago, small, oval ponds of shallow, placid water. Indeed, there can be little doubt that such processes have been consumated and are operative at the present time. (For example, Sand Lake, Lake Tom, and a few smaller lakes of the Northeast portion of Marsh Island, will, probably in the next twenty years, be incorporated into Cote Blanche Bay.) Furthermore, shifts in areas of active sedimentation can bring about refilling of extensive water bodies and conceivably, with subsidence and time, produce a surface reminiscent of conditions prevailing in a region hundreds or thousands of years ago. In geology never ceasing change is a dominant concept and here in southern Louisiana the rapidity of this change is not exceeded anywhere on earth. This is well exemplified in the

Atchafalaya Basin. The basin, which was formed when the low central portion of the Lower Mississippi Alluvial Valley became completely surrounded by natural levee ridges built by various Mississippi River courses (Fisk, 1952, p. 59), contains many extensive lakes (e. g., Grand Lake, Six-Mile lake, Lake Fausse Fointe) that are remnants of a much larger body of water. The area has been, and is at the present time, being filled in by sediment brought down by the Atchafalaya River. A tract of land containing more than fifty square miles has been formed in Grand Lake during the past twenty-three years.

As noted above, an influx of sediment quickly alluviates extensive tracts of water. These extraordinary changes in the land-water boundaries are possible because of the shallow depths found in most marshland lakes and bays.

Depths greater than ten feet are very seldom recorded except in channels. Price (1947) has made some interesting observations on the "average" width (half the sum of the maximum length of open water and the greatest open water diameter roughly at 90° to this) to depth relationships in several of the larger water bodies found in this region. He concludes that there is a rough, but definite and constant ratio of width to depth capable of being plotted as a straight line function. The equation of the line was found to be y = .41x + 3 (y = depth in feet; x = "average" width in miles). However, since soundings for basins with an "average" width of

less than 2.25 miles were lacking at the time, Price states it is not known that the small lakes and tidal basins follow the developed average line. During the last three years many of the smaller water bodies of the region, all having "average" widths of less than 1.5 miles, have been sounded. A plot of seventeen width—depth relations shows that Price's straight line relation (Fig. 12a) does not apply to these smaller lakes (See Fig. 12b). In addition, the writer believes that, although plotted as a line by Frice the graph should show a fairly wide band for depth value readings. In other words an error of one foot or possibly two, as the "average" width increases, is to be expected. The graphs make it obvious that major differences in the size of water bodies do not reflect smilar differences in depths.

Mention should be made of a small group of lakes that do not fall into any of the previously discussed categories. These are the salt dome lakes. On each of the Five Islands there are small topographic depressions that have been naturelly filled by fresh water drainage, forming small, slongate lakes, ponds or swamps. However, in some cases underground solution of salt has caused extensive collapse and relatively large lakes have been formed (e.g., Lake Feigneur on Jefferson Island and Belle Isla Lake in St. Mary Parish).

lakes and bays, of course, are quite obvious on serial

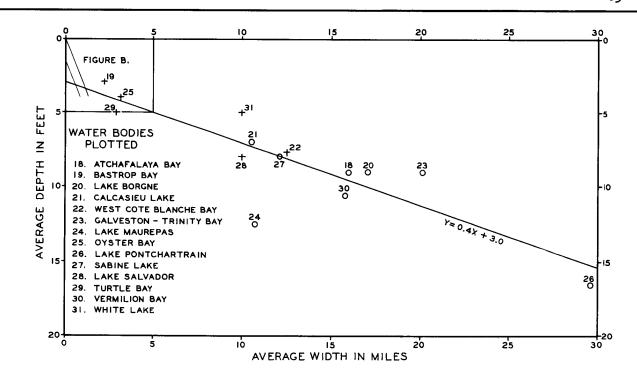


FIGURE 12 A. MODIFIED FROM PRICE (1947). PLOT OF AVERAGE WIDTH TO MAXIMUM DEPTH FOR WATER BASINS OF A HUMID COAST. LINE: Y=0.4X + 3.0 IS LEAST SQUARE AVERAGE FOR POINT DISPERSION. CROSS — BASIN NOT RECEIVING ALLUVIUM DIRECTLY; CIRCLE — BASIN RECEIVING ALLUVIUM DIRECTLY.

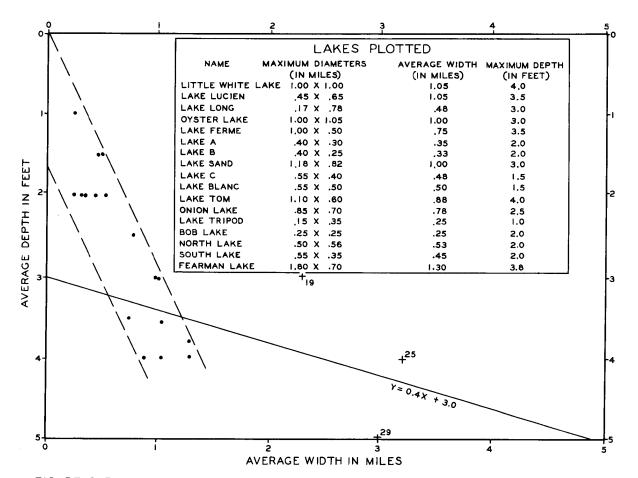


FIGURE 12 B. PLOT OF AVERAGE WIDTH TO MAXIMUM DEPTH OF SEVENTEEN LAKES HAVING AVERAGE WIDTHS OF LESS THAN TWO MILES. NOTE THE DIVERGENCE FROM THE Y=0.4X + 3.0 LINE. POINTS 19, 25, 29 FROM PRICE (1947). (SEE FIGURE 12 A.)

photographs; however, there are many interesting differences in shade. For example, the interior lakes of Marsh Island usually are of a darker coloration than the lakes bordering the bays, and the bays themselves. This color difference is due, primarily, to the amount of suspended material in the water. Suspended particles present many reflecting surfaces to sunlight and consequently lakes or bays containing much suspended material appear lighter on aerial photographs than bodies of clear water which light penetrates with little reflection. In addition, depending on the angle with which sunlight strikes the surface of the water, troublesome glare and reflection may be encountered. Thus, estimation of depth of water from aerial photographs is not practical from the standpoint of coloration alone.

Lake and bay bottom deposits consisting of blue-gray clays, silty clays (Fig. 50) and silts with shells and minor lenticular bodies of silty sands are found throughout the marshlands. The water content of these deposits is often quite high, but considerably less than that of the finer and more organic marsh deposits. The presence of shell fragments, moderate amounts of organic material, lack of oxidation, and higher water content distinguish lake and bay bottom deposits from natural levee material.

DRAINAGE CHARACTERISTICS

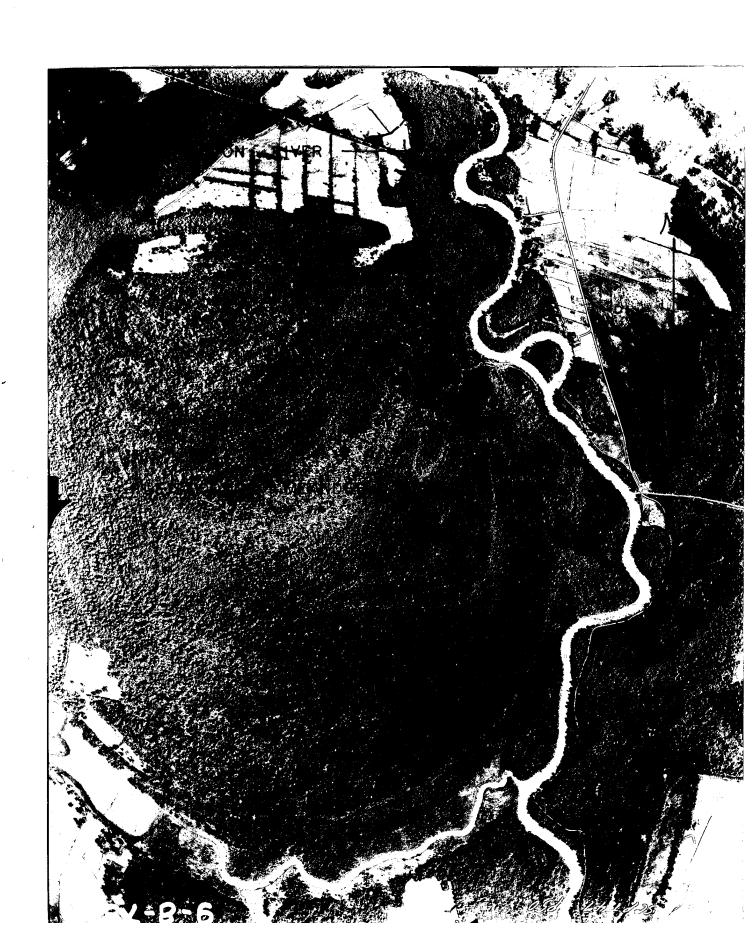
Prairie Terrace Drainage

The undulating, gently gulfward sloping, Prairie Terrace surface is not characterized by good drainage. Rain water rapidly collects in the topographic lows formed, for the most part, by abandoned Pleistocene river channels and the low areas between their leves ridges. The impervious nature of the soil also leads to the formation of the many ponds and swampy areas.

Most of the precipitated water, however, does not collect and stagnate in the topographic lows. Some drains directly into the marsh, and thence to open water. Other run-off follows the old Pleistocene channels (e.g., Little Bayou in Vermilion Parish, Fig. 13) and reaches open water via such atreams as the Vermilion River, Bayou Queue de Torte and the Mermentau River. Many of these small natural drainage channels, locally called "coulees," are found throughout the region.

It is obvious that the drainage of this old deltaic plain (Prairie Terrace) is influenced to a great extent by previously existing drainage patterns. Russell (1939, p. 1227) has pointed out that, "On lower terraces branch-works are being evolved out of old networks, terrace scarp

Figure 13 - Present Drainage Following Pleistocene Meander Scars - South of Abbeville



streams, and meandering flood-plain channels. Their development is determined by uplift and regional tilting toward the active delta of the Mississippi River." Originally then the drainage rattern of the Frairie Terrace closely resembled that of the Recent flood plain and coastal marsh areas; however, subsequent uplift (described in the Geologic History section) has tended to create a more or less tree-like (dendritic) pattern, characterized by uniting of tributary streams to form one major channel. This pattern, however, has not realized complete dominance, and a bastard system of the original floodplain - coastal marsh pattern and the superimposed semi-dendritic complex is characteristic of the Frairie Terrace surface today.

Marshland Drainage

The complex, intersecting network of streams found in the coastal marsh between Bayou Sale' and the Lower Atchafalaya River (Fig. 2) is lacking in any definite trend or alignment. The complex and unpredictable manner in which the streams branch and reunite is characteristic of a marshland drainage network. The haphazard direction of flow and the presence of innumerable small, tortuous bayous also makes it apparent that there are few important near surface alluvial or structural features in the Bayou Sale'--Lower Atchafalaya River area, for the presence of these forms would

be reflected in the drainage pattern. A careful study of the drainage, however, does reveal a few such buried features. For example, a study of the drainage pattern exhibited on aerial photographs revealed a relative "high" extending from Possum Point (Fig. 2) to the vicinity of Clausen (along a line bearing approximately N65°W). Borings made by William McIntire support this observation, as levee material was encountered at depths of five to seven feet in the Possum Point region (personnel communication).

Physiographic features such as chemiers, beaches, and natural levees exposed at the surface, of course, greatly effect marshland drainage. The features often obstruct drainage in such a manner that an elongate lake or stream flow parallel to the obstruction is established. The mouth of the Mermentau River, in Cameron Parish, has been repeatedly forced westward by such encounters with chemier and beach bridges. Southward flowing Yellow Bayou (Fig. 2) turns westward upon reaching the natural levees of Bayou Sale' and parallels them to its outlet in East Cote Blanche Bay.

One might well ponder why near surface alluvial ridges are apparently absent in the coastal region between Wax Lake and the Lower Atchafalaya River. Two possibilities immediately present themselves: (1) no levee systems have crossed this region, and (2) the systems are present but too deeply buried by marsh to allow reflection on the surface. The

second possibility is undoubtedly correct. However, farther west levees of the same approximate age are still discernible on serial photographs. The explanation of this condition probably lies in the fact that more subsidence has taken place in this region than to the westward, for the area overlies a deep trough cut by the Mississippi River during the Pleistocene, thus allowing for more compaction of unconsolidated materials overlying the Pleistocene surface. The Pleistocene plunges from a depth of fifty feet to 180 feet below the marsh surface within a distance of five miles eastward from Possum Point (Fisk, 1952, Plate 14a).

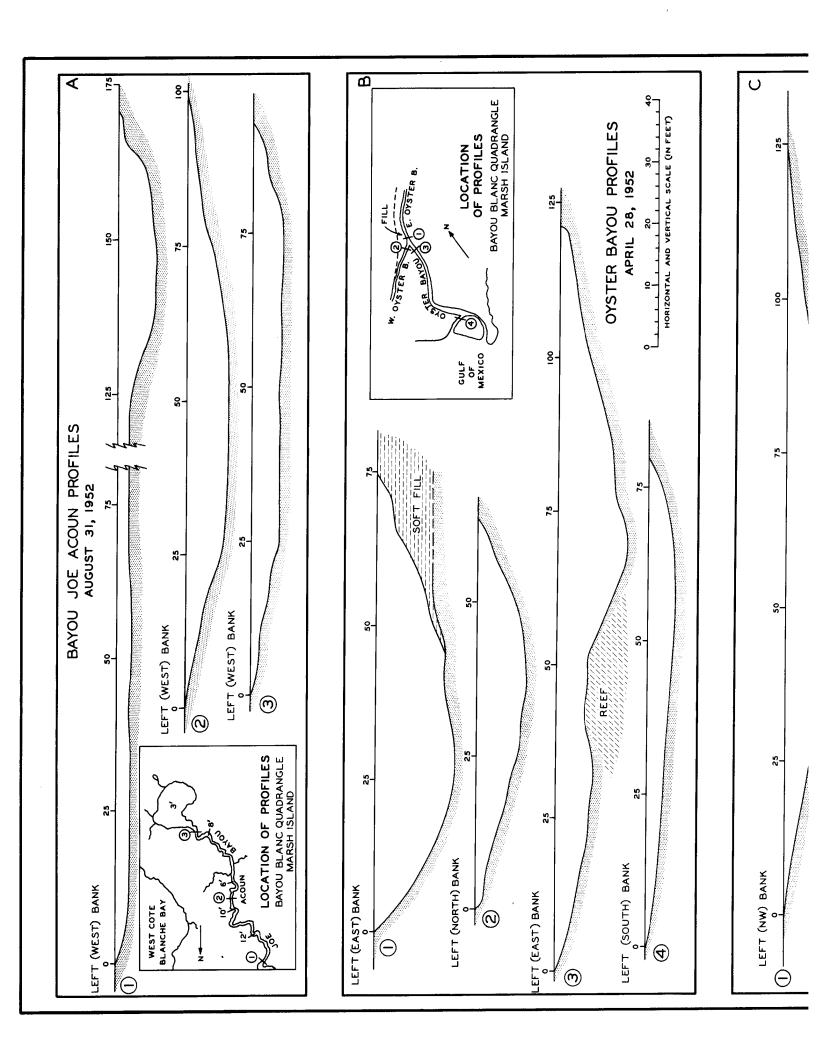
West of Wax Lake, where the Pleistocene is usually less than fifty feet below marsh level, near surface features, such as buried natural levees and chaniers, are often reflected in the topography and drainage. The partially buried, NW trending ridges near the eastern end of Chenier au Tigre stand out as a definite tonal trend or grain on aerial photographs (Fig. 10). The ancient levees of Bayou Cypremort are easily discernible where they intersect the southwestern shore of Vermilion Bay. In addition, the N-S trend of bayous in the northern portion of Marsh Island is suggestive of near surface control. It should be borne in mind that only in areas where the Pleistocene lies at a relatively constant depth and exhibits a uniform slope is the emount of levee subsidence a good criterion for determination of relative age.

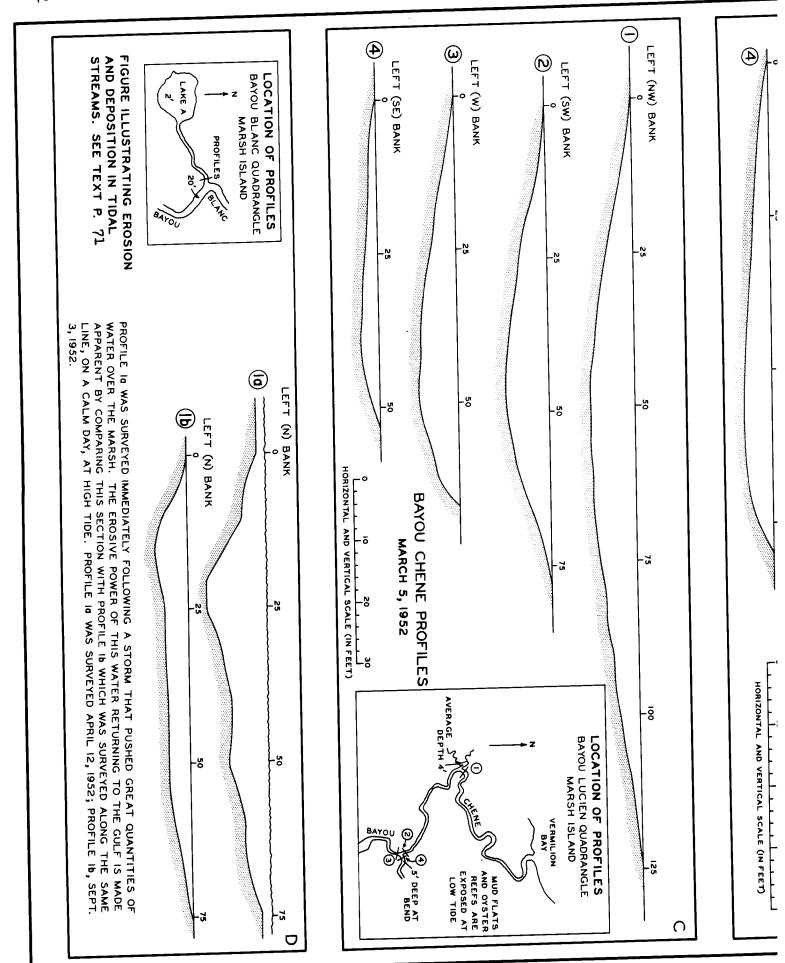
Depths of Marshland Streams

Treadwell (1955), after plotting the depths of over ninety streams, has related stream width to depth in the St. Hernard Parish marshlands. Old abandoned distributaries and open marsh bayous are the two major stream types recognized by Treadwell. This differentiation is very important as deteriorated, more or less straight, channels of ancient distributaries are usually considerably more shoal than winding marsh streams of comparable widths. Treadwell's system makes it possible, after determining stream type and width, to estimate the depth of a marshland stream within a few feet. Unfortunately, primarily due to differences in drainage between the two areas, the present writer has not achieved any comparable degree of success with width-depth plots of streams in central coastal Louisiana. coastal region between Wax Lake and the Lower Atchafalaya River many streams of equal width, with no valid basis for differentiation into separate types, have depth differences as great as ten feet in the reaches (straight portions of the stream). Farther west in the Vermilion and Cote Blanche Bay area the width-depth ratio is fairly good, but not worthy of implicit faith. In this western sector, especially on Marsh Island, many channels are obstructed with oyster reefs. usually lying a foot or so below water level but often exposed at low tide. Such obstructions, of course, completely

invalidate the estimates of depth from the width-depth plot. Figs. 14a, b, and c show several profiles taken along Oyster Bayou, Bayou Joe Acouin and Bayou Chene, on Marsh Island, in an attempt to present a very general idea of width-depth relations in three fairly representative marshland streams. In these figures depths given along the bayous are maximum depths and oyster reefs have, for the most part, been avoided. Of course, it should be realized that reefs will give rise to many local depth variations due not only to their shouling effect, but also to differences in scour and fill action caused by their presence.

Many narrow streams, which drain small marshland lakes exhibit water depths completely out of proportion to their widths. This is a result of the scour which takes place as a consequence of tidal variations which cause alternate filling and emptying of the lake. Bayous draining larger and/or deeper lakes, therefore, have deeper channels. Two interesting profiles have been run on a tidal channel draining a small Marsh Island Lake (Fig. 14d). One of the profiles (Fig. 14d, profile 1b) was completed at fairly high water when a very slight outward flow was in progress. It indicated a maximum depth of approximately five and one-half feet. The other profile (Fig. 14d, profile 1a) was taken immediately after a severe rain and wind storm had inundated the marsh surface to a depth of one and a half feet. There





was, therefore, a strong current in the little bayou, channeling this excess water gulfward, and giving rise to a maximum depth of ten feet; one and a half feet of which can be accounted for by the rise of water level. Thus the small stream had secured out its channel by approximately three feet in a very short time. The increase in depth represents the removal of a cross sectional area of, at the very minimum, fifteen square feet. Considering that the bayou is approximately 3,000 feet in length and that the profiles were run close to its outlet, a reasonable value for the amount of the relatively soft bottom sediment removed would be 15,000 cubic The stream has subsequently refilled its channel to the extent shown in the profile (Fig. 14d, profile la); however, the erosional effect of a single storm on a marshland stream and the subsequent rapidity of refilling is well illustrated.

The depth of the approach channel, leading to a bayou mouth, across shoal bay borders depends, in part, upon the depth of the stream itself. However, the approach channel depth rarely exceeds six feet, even for the largest tidal streams. Finding this elusive, narrow, usually unmarked, pass often presents somewhat of a problem and in areas where oyster reefs are prevalent, presents a definite hazard.

In summary, any attempt to estimate the depth of a marshland stream should take into consideration, at the very

least, the following factors: (1) width of the stream; (2) type of stream—abandoned distributary, tidal, etc.; (3) the presence or absence of oyster reefs—if discernible; (4) area and depth of lake, if any, drained; (5) time of the last storm; and (6) size of the total area drained. The last mentioned factor, in many cases, is difficult to ascertain, for the tangled masses of interconnected lakes and streams found in some areas makes the determination of major lines of drainage impractical.

Effects of Man-Made Structures on Drainage

The effect of artificial canals and levees on marsh-land drainage is in many cases tremendous. For example, on the U.S.C. and G.S. chart no. 200 (1893) the water body now called Fearman lake is shown as two lakes separated by a strip of marsh three quarters of a mile in width. The 1921 U.S.C. and G.S. chart no. 1277 indicated that a narrow cut or pirogue trail had been made joining the two lakes. Today this cut, through natural enlargement, is about 1600 feet wide and three and a half feet deep.

Many oil company canals, with their flanking spoil banks, cross the march giving rise to changes of drainage and hence, vegetation. Although the trappers of the region are probably prone to exaggerate the effects of such canals on the vegetation of their trapping lands, there can be no doubt that changes do occur as a result of their construction.

In addition, artificial levees dam many streams and cause modification of drainage.

The construction of drainage canals, such as the Wax Lake Outlet, has resulted in many alterations. The spoil banks thrown up flanking the channel have effectively divided the lake in half; causing a shoaling of the two portions. Price (1947) formulates that segmentation of tidal basins results in an upset of the equilibrium conditions and shoaling takes place as an adjustment to the newly established "average" width. The effects of the Wax Lake Outlet are more widespread than this, however. Previously fine muds were debouched at the mouth of the Lower Atchafalaya River, some nine miles to the east. The Wax Lake Outlet therefore, in effect, moved a percentage of this sediment supply farther west, and this, along with the increasing flow of the Atchafalsys River has resulted in the rapid accumulation, during the past ten years, of the much flats now found along the Gulf shore of Vermilion Farish.

Thus, relatively minor modifications in marshland drainage may create many unforeseen problems. It is true that in most cases canals cut through the marsh and across lakes tend to fill in rapidly, in which instance, the problem is to keep them open rather than concern over their control. However, the pre-existing drainage should always be carefully considered before any modification is made, whether in

avoiding high maintenance costs or situations that could destroy large portions of the marsh or adversely affect the trapping and shellfish industries.

GEOLOGIC HISTORY OF THE AREA

Age of Sediments Exposed

The strata exposed at the surface within this area are deltaic plain deposits of Recent and Late Pleistocene age. 12 These sediments were laid down within the past 100,000 years or so, 13 and constitute only a thin upper veneer lying upon many thousands of feet of older strata. Near the Gulf shore the maximum thickness of the Pleistocene and Recent deposits is approximately 3,000 feet (Fisk, 1944, Fig. 70).

Fisk (1938) has established a four-fold division of Pleistocene deposits, the youngest or Prairie formation being the only one exposed at the surface in this region. 14 The division is based on the modification of sedimentation

Possibly Tertiary exposures are found on some of the Five Islands.

¹³ Fisk's (1944, 1947, 1952) dating for the Fleistocene and his formational breakdown will be followed in this report. It should be borne in mind, however, that the actual dates are still very much in question. Trowbridge (1954) has recently made a fairly exhaustive search of the literature and presents average figures, which differ from those of Fisk. For example, the beginning of the Recent as given by Trowbridge is approximately 15,000 years ago, which is 10,000 years later than the 25,000 year estimate of Fisk;

Woodward and Gueno (1941) have presented a geochronic synonymy of Pleistocene formations and terraces of the Gulf and Atlantic coestal plains that is extremely helpful when doing Pleistocene research in this region.

caused by Pleistocene oscillations in sea level. oscillations were, in turn, the result of periodic accumulation and outward spread of glacial ice from polar centers. Such amassment of ice caused a drop of several hundred feet in sea level, therefore, due to the lowering of base level, the gradient, velocity, turbidity, and transporting power of the Gulf Coast streams increased. Thus the streams became entrenched and great quantities of coarse sand and gravels were carried to the Gulf. Later, as the ice sheets retreated, returning the meltwater to the ocean and causing the sea level to rise to about its former position, 15 the entrenched valleys were alluviated, in an effort to adjust to the new base level, by the same streams that out them. The lower portion of this alluvium consists of coarse sands and gravels, but as the sea (base-level) continued to rise both the quantity and the grain size of detritus supplied to the rivers was diminished; the alluvium deposited in the valleys became progressively finer grained, and the rate of valley alluviation decreased. This finer material is called top-stratum

¹⁵ Baulig (1935) postulated that there has been a general lowering of sea level since late Cenozoic times (not connected with glaciation), and that the Pleistocene variations in sea level were mere fluctuations in this downward trend, which was possibly caused by deformation and deepening of the ocean basins. Baulig's ideas do not agree with Fisk's hypothesis that after each glaciation sea level returned to the same approximate position.

and the valley-filling portion of the Prairie Terrace, therefore, consists of a coarse basel substratum overlain by a finer grained top-stratum.

The Prairie Formation was laid down during that portion of the Peorian Interglacial Stage (Fig. 15a) when the sea level was rising (extending from about 110,000 to 70,000 years ago). Approximately 70,000 years ago the polar ice caps began to expand, lowering sea level and forcing the coastal plain streams to cut trenches in the newly formed Frairie surface. This valley cutting continued until approximately 25,000-15,000 years ago when the ice again began to retreat; adding its meltwater to the oceans and raising sea level to about its former position. It is probable that the major portion of this rise occurred between 25,000 and 8.000 years ago, and that a slower, more inconsistent rise has been taking place since this time. A rise of sea level, during the last fifty to 100 years, has been noted by Marmer (1949 and 1952) and Umbgrove (1950). These and other observations seem to indicate that we are not yet through the Glacial Ages. This last (25,000-15,000 years ago to the present) rise in sea level, marked by minor fluctuations, has resulted in the formation of the Recent surface, which comprises the greater part of the area under discussion.

A concise summary of the more important events and processes of the Quaternary Period is presented by Fisk

(1952, pp. 34-5):

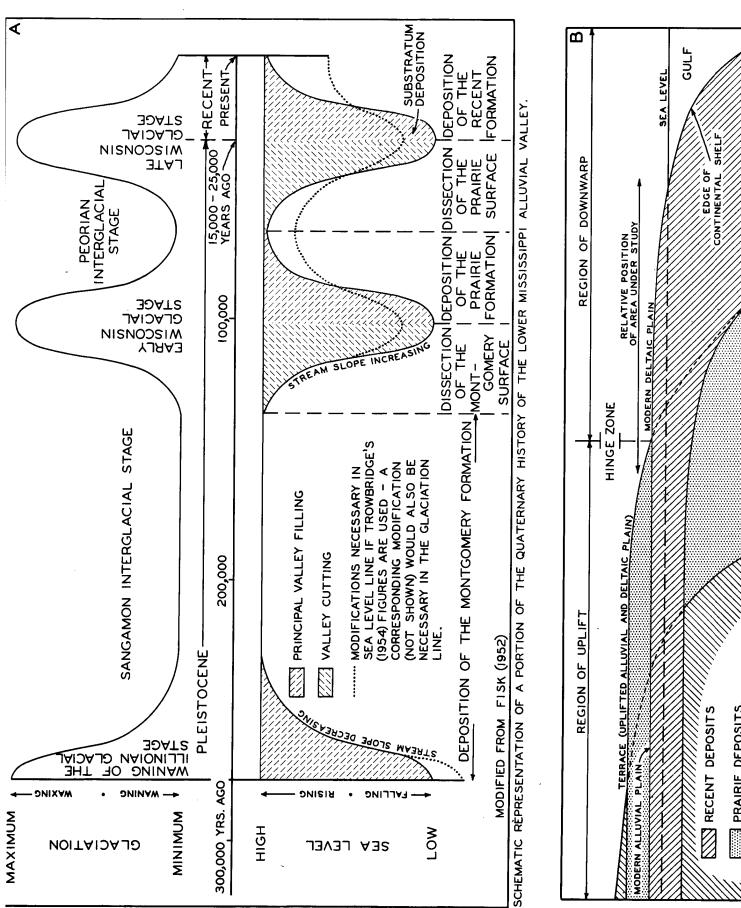
Evidence is available in the alluvial deposits of the Lower Mississippi Alluvial Valley and adjacent areas that sea level was lowered and later restored to mear its present stand five separate times. Each oscillation of sea level can be correlated with an advance and retreat of the glacial ice, and the intervening period of stationary sea level can be correlated with an interglacial stage. The relationship between chronology developed in glaciated parts of the continent and Lower Mississippi Valley stratigraphic units is shown by Figure 8a. A typical glacial cycle is shown by Figure 8b. Figures 8a and 8b of Fisk are reproduced in the writer's Fig. 15a and b.

The regularity of the cyclical pattern of valley entrenchment, valley filling, and alluvial plain development is complicated by the structural activity which accompanied river mouth deposition and affected the Louisiana coast throughout the Quaternary period. Each alluvial plain was downwarped in its deltaic portion and contemporaneously uplifted inland. The uplifted portion became an alluvial terrace and formed the walls of the next later entrenched valley system. Adjacent to the present Mississippi Valley are four terraces, representing four former floodplains, each with its characteristic sequence of alluvial deposits. The oldest floodplain forms the highest terrace.

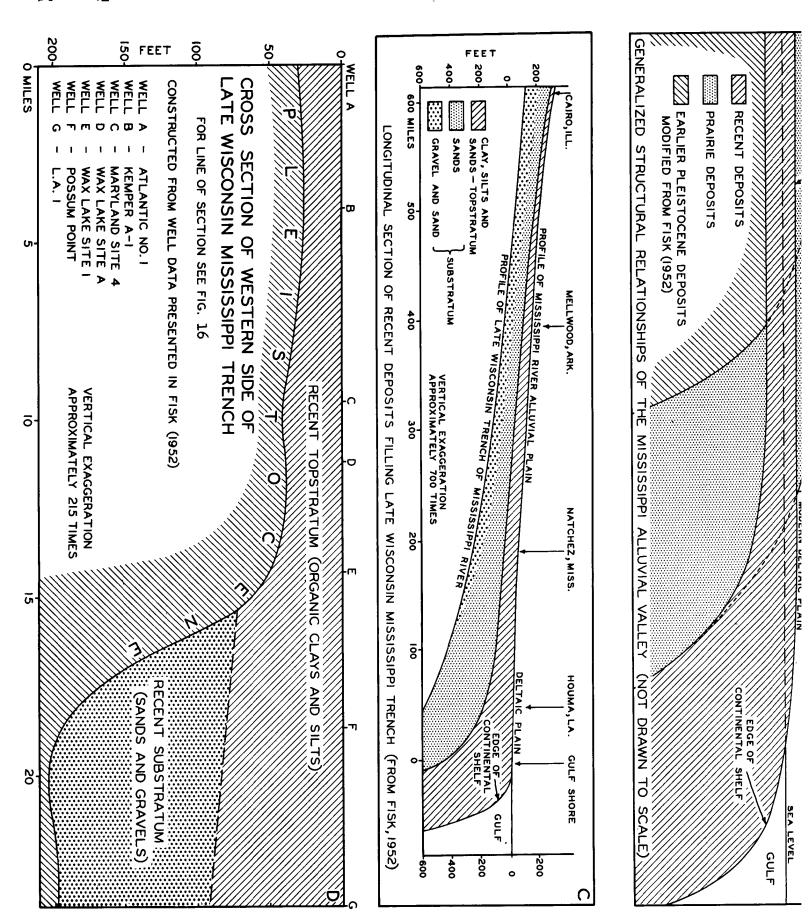
very flexible differentiation between floodplain or alluvial plain, which parallels the stream in its valley, and the deltaic or coastwise plain, which parallels the coast and is usually more or less perpendicular to the general direction of stream flow, is very important. Each terrace surface originally consisted of these two areal divisions. It should be noted at this time that the bi-partate division of these deposits, coarse basal and finer upper portions, usually pronounced in the floodplain formations is not as easily noted in the coastwise deposits.

In this area the Pleistocene exposures consist of the Prairie deltaic plain, whose irregular surface is overlapped, along its borders, by Recent deposits (see Figs. 3 and 4). On Fig. 15c note the approximate location of this region southward of the hinge zone. This location, on the downwarped side of the flexure, makes it possible for the Recent sediments to overlap the Prairie celtaic plain. North of this hinge zone the equivalent deposits (Prairie alluvial plain), flanking the Mississippi Valley, rise above the Recent floodplain, forming, in part, the valley walls. Therefore, the Recent deposits are in reality an incipient terrace formation and should the ice sheets advance and retreat once again the present deltaic plain would be downwarped and buried; whereas, to the north the present floodplain would be uplifted and dissected.

onic terrace formation, there is little basis for the breakdown of these deposits into the two members proposed by
Jones (1954, p. 88). In effect, Jones has tried to separate
the floodplain deposits from the deltaic or coastwise sediments by drawing an arbitrary line, thus creating two essentially equivalent members in his so called Lo Moyen formation, which includes all the Recent deposits. This line,
drawn southeastward from Franklin, actually lies within the
deltaic plain of the Mississi, pi River as defined by Russell



GENERALIZED STRUCTURAL RFI ATIONSHIPS OF THE MISSISSIDDE ALTENNAL VALLEY EARLIER PLEISTOCENE DEPOSITS MODIFIED FROM FISK (1952) PRAIRIE DEPOSITS



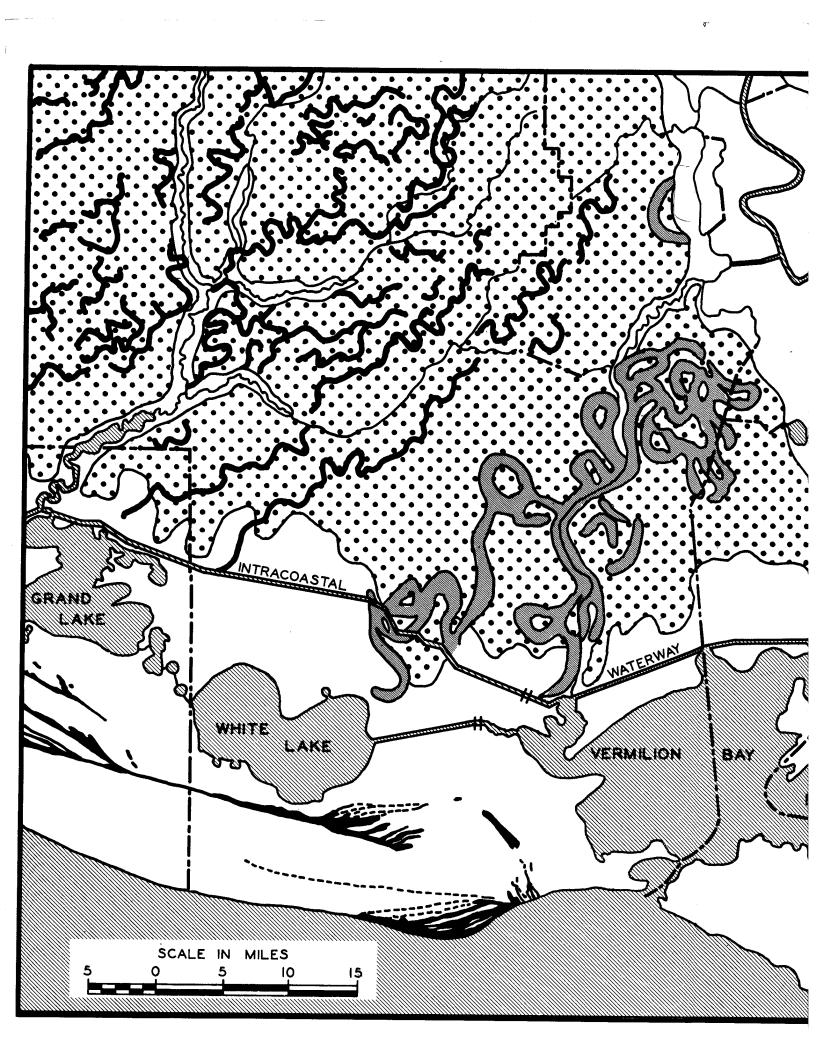
(1936, p. 47). Jones' basis for the breakdown lies in the fact that one member of his Le Moyen formation (Le Beaufloodplain) contains a large amount of sand or sand and gravel in the lower part (substratum of Fisk) and the other member (Mercentau-constwise) consists primarily of silty clay or clay. However, the coarse material lies in the Pleistocene trough of the Mississipi River, thus the upper portion of the Le Beau member is predominantly of the same lithology as the entire Mermentau member. In Fig. 15d, according to Jones' breakdown, the Recent deposits west of the general locality of Maryland Site #4 would be included in the Mermentau member of the Le Moyen formation; whereas, the Recent deposits to the east, form the Le Beau member. In the writer's opinion, it would be better, but hardly necessary, to give the overlying fine material (top-stratum and coastwise deposits) member rank and to do likewise with the bands of basal coarse material (substratum).

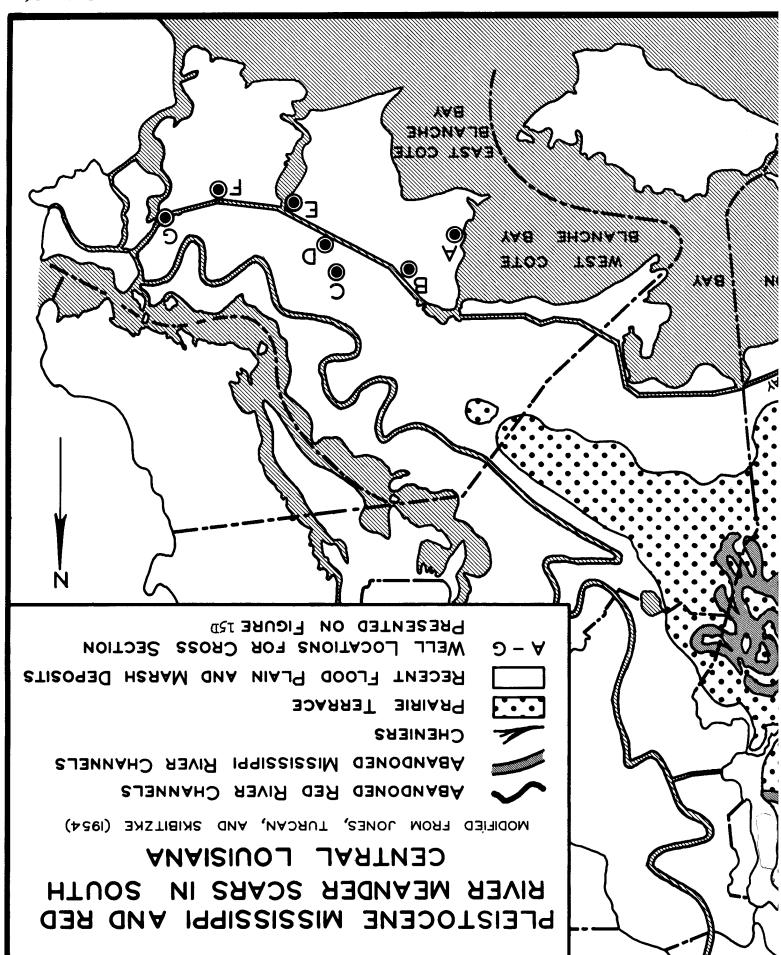
The writer can see no objection to giving the Recent deposits formation rank, but he does not feel that further breakdown is necessary. In the present report the Recent deposits will be considered as a unit, including all the complexly intercalated marsh, mudflat, beach, levee, back swamp, estuarine, and lacustrine sediments that are separated from the underlying Pleistocene deposits by a pronounced erosional unconformity.

Origin of the Prairie Surface

The Prairie surface in Southwest Louisiana is crossed by numerous scars of ancient stream courses. Several southwest trending scars. of old Red River channels, cut the northwest corner of Vermilion Parish south of Crowley. Similar scars are found to the northwest in Acadia and Jefferson Davis Parishes (Fig. 16), all maintaining, more or less, the southwest trend. A twenty mile wide belt, extending southsouthwest from Lafayette, exhibits wonderfully preserved, although somewhat subdued, meanders of a late Fleistocene river of the size of the present Mississippi (Fig. 16). South of a line joining Kaplan and Abbeville this zone apparently splits into two distinct belts; one, trending south from the vicinity of Kaplan, turns westward upon approaching the present marsh contact; the other, continues directly south from Abbeville. The Vermilion River occupies the latter scar throughout most of its course. Headward erosion by entrenched Pleistocene (Late Wisconsin) streams and lateral cutting by Recent Mississippi Rivers has eroded away portions of the Frairie surface, forming the northwest trending scarp along its eastern margin and destroying most of the Pleistocene meander belt north of Lafayette.

The band of relict Pleistocene meanders locally forms the highest portions of the terrace surface and the land slopes gently away from these elevations. Thus, the drainage





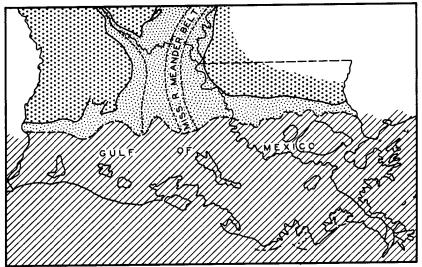
pattern is primarily dependent upon the relict channels and alluvial features of the ancient stream. This zone is also reflected in the subsurface by thinning of the clay topstratum of the Prairie formation. Along the meander belt of the ancestral Mississippi River the clay is usually less than fifty feet thick (in many cases less than twenty feet), whereas, on the western and eastern margins the clay is much thicker reaching a thickness of 100 feet within five or so miles of the belt (Jones, 1954, Plate 4). Similar distribution and thickness of meander belt and flood plain deposits is exhibited in the valley of the modern Mississippi River.

risk (1948) has presented a series of diagrams illustrating the Late Pleisto cene history of this region. The following discussion will, in part, merely elaborate on his conclusions, as illustrated in Fig. 17. The interpretations drawn from, and the causal forces resulting in, deposition and entrenchment do not, however, in all cases, agree with those suggested by Fisk. Dr. Fisk should not be held responsible for any statements not quoted or not directly concerned with the chronological sequence as presented in Fig. 17.

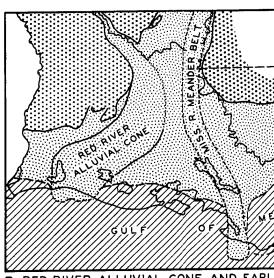
Previous to the time illustrated in Fig. 17a (i. e., during the Early Wisconsin Glacial Stage), sea level was lower by several hundred feet. Streams had formed entrenched valleys, in adjustment to the lower base level and increased

LATE PLEISTOCENE GEOLOGIC HIST

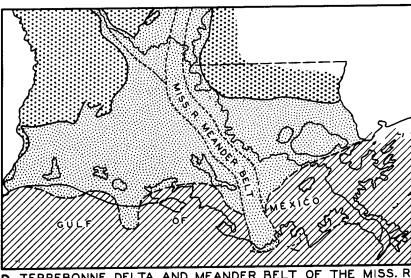
MODIFIED FROM FISK (



A EARLY SHORELINE OF PRAIRIE DELTAIC PLAIN.

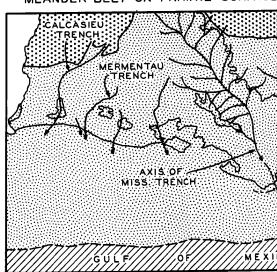


RED RIVER ALLUVIAL CONE AND EARLY MEANDER BELT ON PRAIRIE SURFACE



D TERREBONNE DELTA AND MEANDER BELT OF THE MISS. R. DURING LATEST PRAIRIE TIME.

(B) INDICATES CORRELATION OF STAGE SHOWN BY DIAGRAM B.



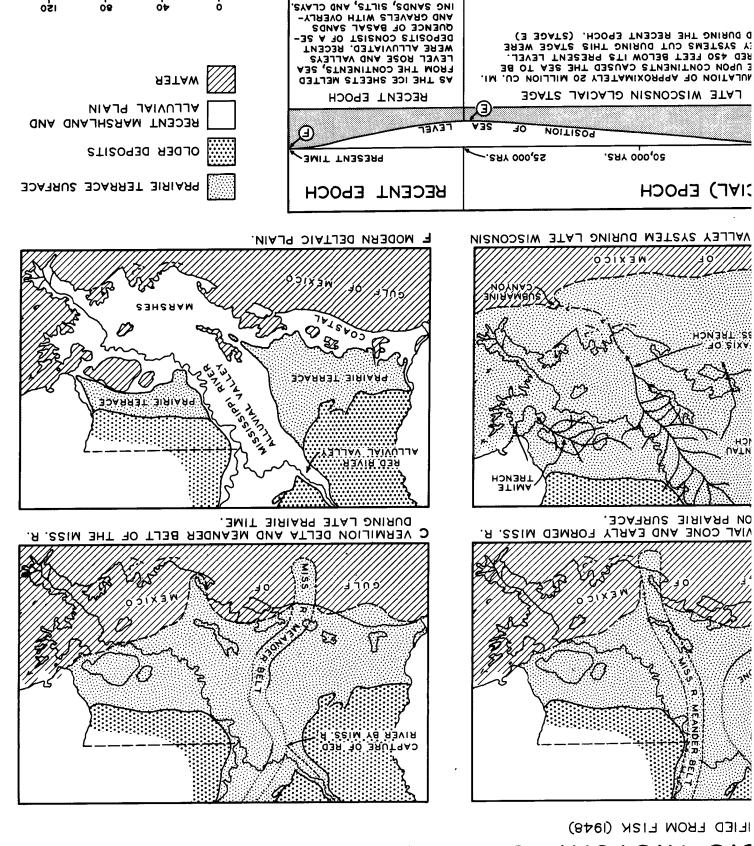
ENTRENCHMENT VALLEY SYSTEM DUR GLACIAL STAGE.

LATE STAGES OF THE PLEISTOCENE (GLACIAL) EPOCH 50,000 YR\$ 75,000 YRS. 100,000 YRS. 125,000 YRS. -150,000 YRS. C 0 LEVEL **(B)** POSITION OF SEA (A) PEORIAN INTERGLACIAL LATE WISCONSIN GL EARLY WISCONSIN GLACIAL STAGE **STAGE** ACCUMULATION OF APPROXIMAT ACCUMULATION OF ICE UPON CONTINENTS WITH SUBSE-OF ICE UPON CONTINENTS CAUS QUENT LOWERING OF SEA LEVEL RESULTED IN ENTRENCH-MELTING OF ICE SHEETS FROM LOWERED 450 FEET BELOW ITS MENT OF STREAMS AND VALLEY CUTTING. ENTRENCHMENT CONTINENTS CAUSED A RISE IN VALLEY SYSTEMS CUT DURING VALLEYS DEVELOPED DURING THIS STAGE WERE FILLED SEA LEVEL AND ALLUVIATION FILLED DURING THE RECENT EF DURING PEORIAN INTERGLACIAL STAGE. OF VALLEYS CUT DURING PRE-VIOUS GLACIAL STAGE. SEDI-

TION.

MENTS LAID DOWN DURING THIS STAGE FORM WHAT IS NOW CALLED THE "PRAIRIE FORMA-

SIC HISTORY OF SOUTH LOUISIANA



SCALE IN MILES

discharge, thich extended far beyond the present shoreline. Gradually, however, as the polar ice melted (Feorian Interglacial), sea level consequently rose and arms of water slowly crept into the entrenched valley systems. In all cases the magnitude of rise exceeded the depositional ability of the stream and, although tremendous quantities of sediment were debouched, the relentless fingers of water probed further inland, thus bringing estuarine and marine deposits, underlain by fluviatile sands, headward along the valley floor. Therefore, along with the surficial tongue of encroaching water a similar, sub-sea wedge of coarse alluvium was extending up-valley.

Finally a point of equilibrium was reached and, due primarily to deceleration of sea-level rise, the shoreline no longer retreated. About this time the Mississippi and Red Rivers begen to build their deltaic plains seaward, as illustrated in Fig. 17a. Farther apstream floodplains consisting of natural levee and back swamp deposits were forming. Thus, in the main troughs coarser alluvium was blanketed by finer material. As the deltaic plain advanced seaward and expanded laterally, with many shifts in river course, the estuarine and marine deposits, overlying the basal fluviatile sands

¹⁶ An increase in discharge seems probable as numerous data support the contention that rainfall increased greatly in the inland regions during glacial periods.

(in the trough) and older Pleistocene deposits (on the divides), were overlapped. Fig. 17b shows the approximate maximum extensions of the Mississippi and Red River deltas, previous to the westward shift of the Mississippi River and its capture of the Red River. The shift occurred relatively late in the Peorian time and the Red River never again flowed independently to the gulf during the Pleistocene. The combined streams now built, what Fisk has termed, the Vermilion Delta gulfward from the vicinity of White Lake (Fig. 17c).

Another great change occurred in the construction of the Prairie deltaic plain when the Mississippi River again shifted its course to the east and constructed a delta seaward of the area which is now Terrebonne Parish (Fig. 17d). As Fisk (1948, p. 28) states:

There are two reasons for assuming that this shift occurred and for establishing its position. The Vermilion-Mississippi meander belt is cut into on its eastern side in the Marksville Hills area by a younger series of meander scars of Frairie age. This relationship shows that the Mississippi River had a younger course than the Vermilion and that it flowed to the east of the Vermilion meander belt. The second reason for interpreting an eastward shift of the Mississippi River is that the mester stream had to have such a position east of the Vermilion meander belt in order to become entrenched where it did during the Late Wisconsin glacial stage.

Fig. 17d shows the course of the Mississippi River immediately preceding the lowering of sea level accompanying the Late Wisconsin glacial stage. With the lowering of sea level (base level) and increased discharge, entrenchment of the streams in the newly formed Prairie surface took place

(Fig. 17e).

The unveiling of the Recent Epoch is marked by the beginning of another rhythmic rise in sea level. The entrenched valleys, cut in the Frairie surface, were thus converted into estuaries and embayments bottomed with coarse fluviatile deposits and overlying estuarine and marine sediments. Gradually, in areas where deposition could keep pace with the decelerating rise in sea level, 17 deltaic filling of these embayments began, and is still in progress at the present time. It should be noted that the sediments overlying the divides between entrenched streams would rarely exhibit the same sequence as those found in the troughs (Fig. 18a). Therefore, the basal substratum is not necessarily continuous, coastwise, in any of the deltaic terrace formations or, obviously, in the Recent deposits. Thus subsurface correlation of the terraces, on the basis of finding a coarse basal zone, is very hazardous in some areas.

A comparison of Figs. 17d and 17f shows that of the originally deposited Prairie deltaic- and flood-plain less than one-half of its original area is exposed at the surface today. Headward erosion of the entrenched streams formed during the Late Wisconsin Glacial Stage, lateral erosion by

¹⁷ The presence or absence of fluctuations in this last great rise of sea level is still a debatable problem.

Recent Mississippi Rivers, and the overlapping of Recent deposits, caused by subsidence and rise of sea level, have combined to obliterate and conceal many features of the old surface. However, many observations can be made from its exposed portions and, being the youngest and least dissected of the terrace surfaces, most of the interpretation of Pleistocene deposition is based upon study of the Prairie formation. The mode of origin is made relatively clear by the presence of large, well preserved meanders. Fisk (1948, p. 28) also observes:

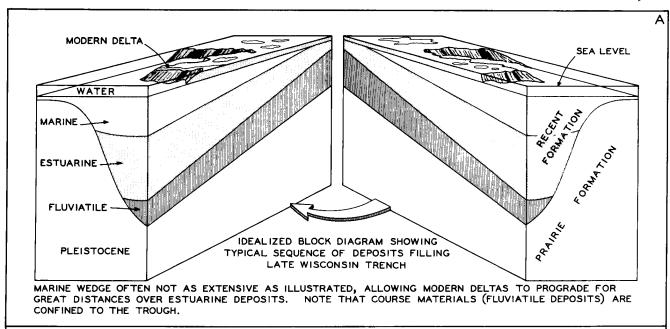
At the peak of its development, the Vermilion delta of the Mississippi River probably extended beyond the present shoreline to the edge of the continental shelf /Fig. 17c/. This opinion is based on the fact that the only traces of the Mississippi River left in Vermilion Parish are those of a widely meandering stream. Similar traces along the modern Mississippi River are not found closer than 150 miles above the Head of Passes. It is concluded therefore that the mouth of the Frairie Mississippi River lay a great distance south of the Vermilion Farish traces of its channel.

Fisk (1944, 1948, 1952) has outlined the Pleistocene history of the Mississippi Alluvial Valley. However, a detailed review of Pleistocene geology is beyond the scope of this report; the main objective being the interpretation of the deposits flanking the Prairie surface—Recent sediments.

Origin of the Recent Surface

As previously stated, the Recent sediments are separated from the underlying Pleistocene deposits by a pronounced

В



APPROXIMATE TIME EQUIVALENCY OF SUGGESTED PHYSIOGRAPHIC AND CULTURAL CHRONOLOGIES FOR THE LOWER MISSISSIPPI ALLUVIAL VALLEY

PHYSIOGRAPHIC CHRONOLOGY OF FISK (1944)						CULTURAL CHRONOLOGY OF PHILLIPS, FORD, AND GRIFFIN (1951)	
EPOCH	SEA LEVEL	DURATION OF STAGES	STAGES	TRUNK COURSE	DELTA SYSTEM	DATE A.D.	CULTURE
	STANDING SEA LEVEL	HISTORIC COURSES	20 (1939 -43) 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2	PRESENT MEANDER BELT	PLAQUEMINES- ST. BERNARD	— I700 —	HISTORIC
		STAGES LOOO YEARS LOOO YEARS LOOO YEARS LOOO YEARS LOOO YEARS LOOO YEARS LOOO YEARS				—ı500—	NATCHEZ
⊢						1200	PLAQUEMINE
				WALNUT BAYOU	LAFOURCHE	1200	COLES CREEK
Z							TROYVILLE
						500_	MARKSVILLE
LJ ()					TECHE		TCHEFUNCTE
Ы			J H G	COCODRIE	COCODRIE	0	*POVERTY POINT
α.			F E				
		UNEQUAL LONG TIME STAGES	D	SUNFLOWER .	MARINGOUIN		*FORD, PHILLIPS, AND HAAG (1955)
			C ₂ C ₁ B ₃ B ₂		BAYOU LA ROSE		
	RISING SEA LEVEL	3,000 YEARS	В	YAZOO BURIED	(BURIED)		
WANING			A ₃				
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erosional unconformity and consist of complexly intercalated marsh, mudflat, beach, lacustrine, estuarine, levee, and backswamp sediments. In Central Coastal Louisiana the Recent floodplain is restricted to the northeastern portion of the area, while typical deltaic deposits compose a Gulfward thickening wedge of complexly interfingering Recent sediments south of the exposed Prairie surface. Each type of deposit, with its vertical and lateral changes, provides a clue to the interpretation of the sedimentary history of the immediate area and of coastal Louisiana. The history of coastal Louisiana is probably more easily read in this region tian in any other similar area. Here some of the older Recent Mississippi deltas found their first expression and, as subsequent shifts of the active delta have been to the eastward, their traces have not been completely obliterated. The later deltaic shifts have been recorded in the chenier systems, which mark shoreline fluctuations in the area.

Therefore, the following pages will deal primarily with the major Recent physiographic features of the area in an attempt to (1) describe their manner of origin, (2) interpret their significance in the history of coastal Louisiana, and primarily, (3) establish their relative ages. The natural levees of Bayou Sale?, Cypremort, Teche and Vermilion plus the chemiers, and beaches, constitute the major Recent

physiographic features of interest. 18 They will be examined in sequence.

The pre-historic cultural chronology established by Phillips. Ford and Griffen (1951) has been used extensively in the following section as an indicator of relative age. This chronology is based on changes in pottery type and ornamentation that accompanied development of Indian cultures. Potsherds bearing a particular design or pattern are thus considered indicative of a certain time period (Fig. 18b). The presence of such artifacts on the levees of an abandoned stream thus suggests that the flow, during this culture period, was sufficient to sustain an Indian settlement. Fotsherds and other artifacts are usually concentrated in middens, composed primarily of Rangia shell, which represent the refuse heaps of the Indian settlements. Fisk's (1944) river chronology, based on physiographic and bore hole evidence, is also frequently mentioned. Familiarity with the relative ages of the divisions in both classifications and their time equivalency (Fig. 18b) is essential for the comprehension of the material to be presented.

¹⁸ The Five Islands, partially of Recent origin, will not be discussed separately, however, mention of their origin and its effect on the other physiographic features will be made.

Bayou Sale' System

Although located in an important region of early settlement, Bayou Sale' itself is very seldom mentioned in the literature. Scattered statements, however, indicate that there was no through flow in the bayou when white men settled in the area.

Cathcart (1819, p. 98) refers to the bayou as ". . . nothing more than a winding gully fifteen feet wide, and from twelve to eighteen inches deep filled with Cypress knees. . . " Read (1927, p. 182) states:

Bayou Sale' in the parish of St. Mary takes its name from the French participial adjective sale', "salted," "salt." That sale' is the origin of the name, and not the French sale, "foul," "dirty," is clearly proved by the earliest records.

In other words the bayou has been estuarine and receiving only rain water flow since earliest recorded time.

The forests flanking the bayou received slightly more attention. Levin Wailes, Register of the Land Office at Opelouses in 1814, in a letter to Catheart (1819, p. 175) describes the oak forests along the bayou and also states, "There is likewise a tongue of Wood land, probably live Oak, extending about a mile and a half along the Coast." The remnants of these forests can be seen today near the mouth of the present bayou and along the coast where its leves flank the shoreline (Fig. 7).

An article appearing in the November 11, 1847 issue

of the Planter's Banner describes the bayou region as follows:

The Bayou Sale' of itself possesses no remarkable interest as a watercourse; indeed it is not considered a navigable stream; small boats, however, may ascend it for some distance from its mouth; . . . The Bayou Sale' takes its rise near the west margin of the Teche, about seven miles below Franklin, . . . and after pursuing a westerly course of about 30 miles through a ridge of land of unrivalled fertility, both prairie and woodland, it empties into what is called Bayou Sale' Bay (East Cote Blanche Bay). . . .

This strip of country, which some 30 years back was considered of little value, is now a chain of sugar plantations for the whole extent,...

Dennett (1876, p. 98), Hilgard (1884, p. 157) and Perrin (1891, p. 8) also mention the forests and sugar plantations of Bayou Bale', but give very little in the way of physiographic descriptions.

Today the bayou is estuarine, owes any water flow (except tidal) to local rainfall, and, with the exception of the extreme distal portion where it has been dredged to a depth of approximately nine feet, is almost completely filled with vegetation.

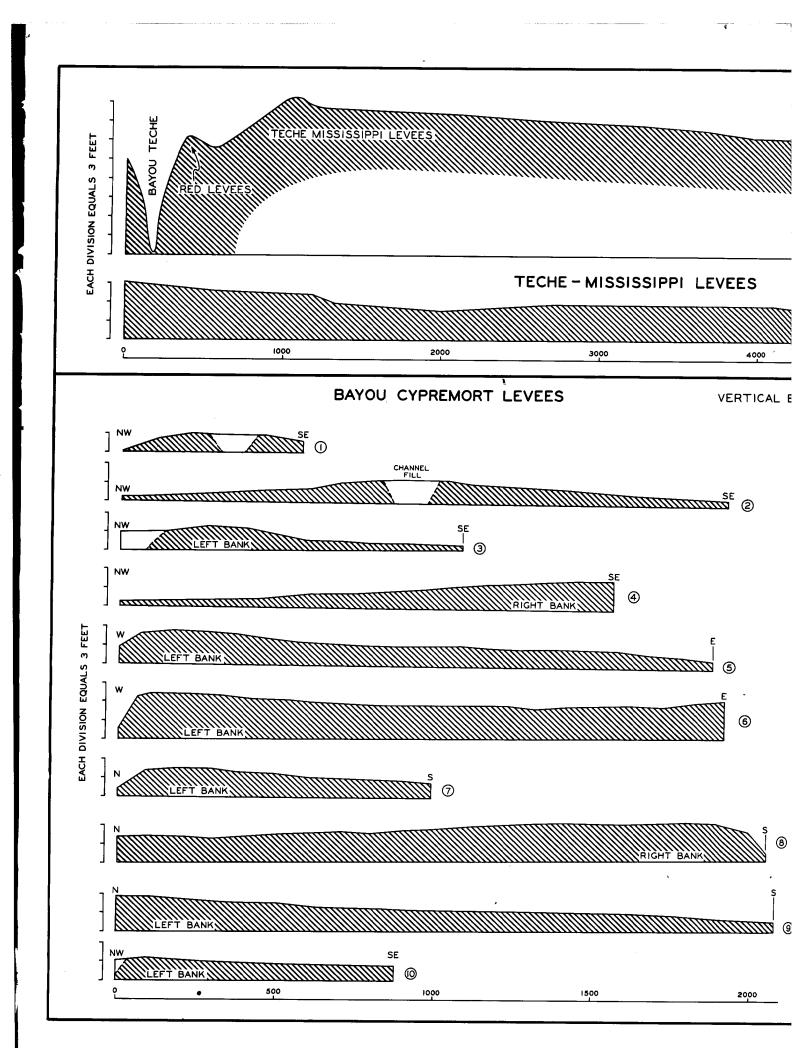
The stream has received little attention in more recent publications. Fisk (1944, Plate 15), for example, does not definitely include Bayou Bale' in any of his delta systems. However, on one figure (Fisk, 1952, Fig. 14) the stream is shown as part of the Maringouin delta system. This connection is not mentioned in the text.

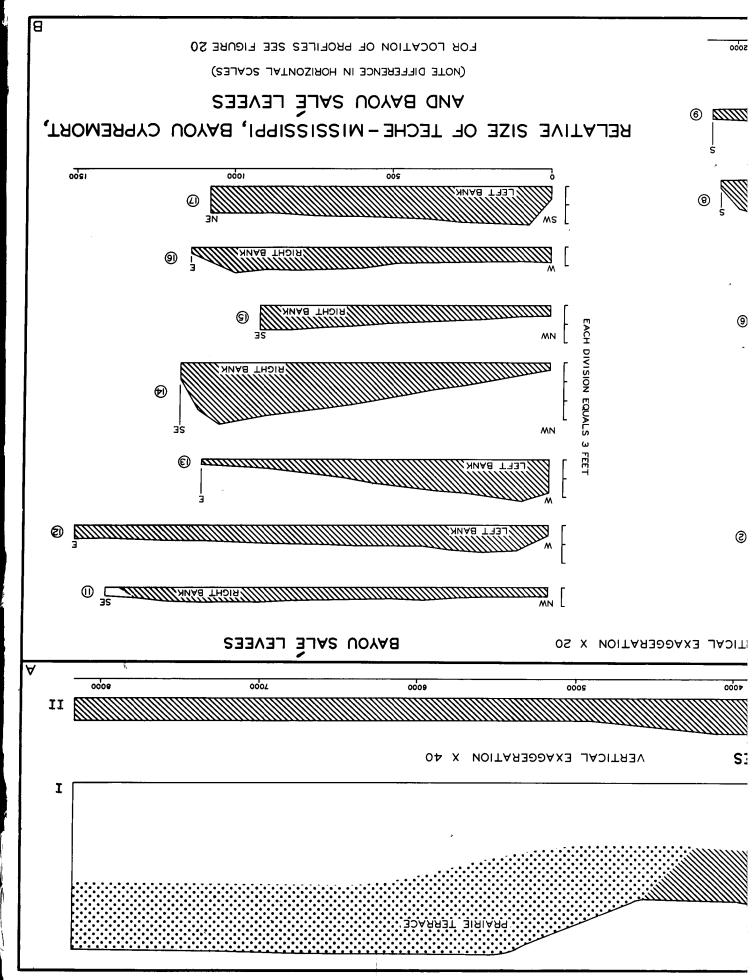
Field work, combined with aerial photographic study,

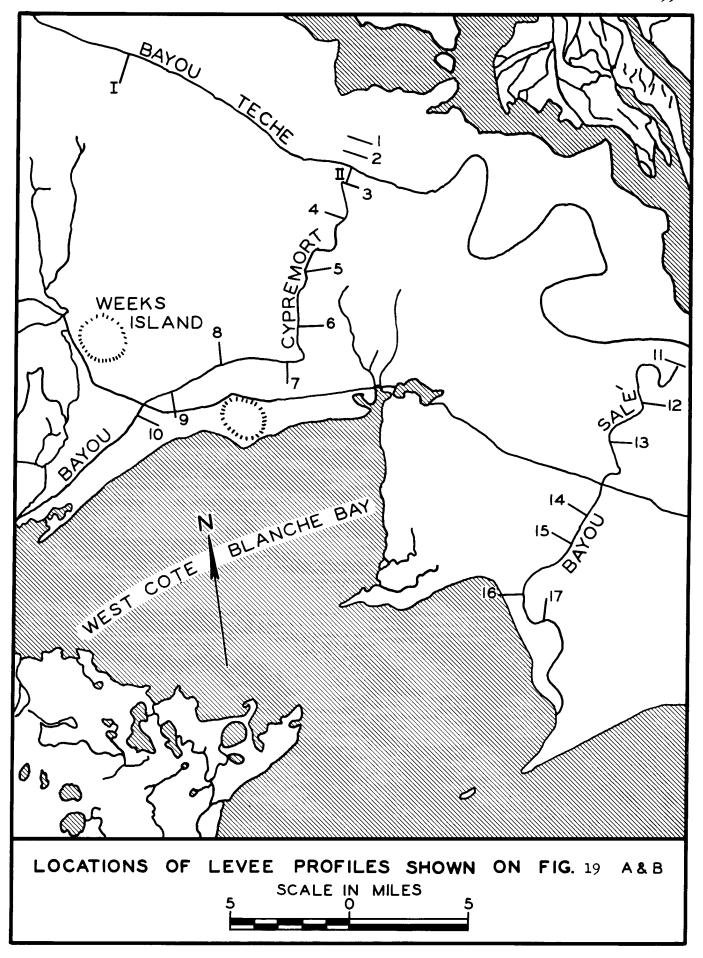
in the Bayou Sale' region has revealed several interesting facts.

- (1) The existing natural levees flanking Bayou Sale' are steep, narrow and of a size not comparable with the levees of former Mississippi Rivers.
- (2) Accretion sears, near the present Teche-Sale' junction, indicate that Bayou Sale' functioned as a distributary of the Teche-Mississippi, but apparently became sealed off prior to Red River occupancy of the Teche.
- (3) Two broad, marsh-covered natural levee ridges diverge southward from the Bayou Sale' trend between Bayou Teche and the Intracoastal Canal.
- (4) Artifacts suggesting Indian occupation during pre-Tchefuncte time have been found northeast of Belle Isle, at Negro Hammock, and on Rabbit Island (Fig. 2).
- (5) Various evidence indicates that a continuation of Bayou Sale' exists to the north side of the Teche ridge.

The fact that the existing levees of Bayou Sale, were formed by a relatively minor stream is obvious from their narrow, steeply sloping profiles and their size relationship to the Teche-Mississippi levees (Fig. 19). This steepness is the result of the attempt by a distributary to build its levees to a height comparable to those of the main stream. As the volume of water, and hence the amount of suspended sediment, available to the distributary is considerably less







than that of the main course, narrow steep levees are formed. 19 Many examples of this situation can be found in the active delta of the Mississippi River.

Although partially obliterated by subsequent cultivation, an interesting pattern of accretion scars is exhibited in the Sale'-Teche junction area (Fig. 21). The scars suggest that Bayou Sale' left the Teche-Mississippi River approximately 1.3 miles above its last occupied channel. This accretion pattern, showing downstream migration of a distributary channel is typical of stream action. Welder (1955) has presented an excellent discussion of this type of channel closing and resulting accretion scars.

Thus evidence indicates that the existing, cultivated levees of Bayou Sale' were formed when the stream functioned as a distributary of the Teche-Mississippi River. However, older, broader, marsh-covered levee ridges are present in the Bayou Sale' region.

The drainage pattern, as delineated on aerial photographs, reveals a relative "high" extending from Clausen to

¹⁹ Naturally, as is obvious from Fig. 19, leves flanking an abandoned course will vary considerably in steepness owing to their position along the stream (cut bank, reach, etc.), differential compaction of underlying sediment, nearby tectonic uplift (e.g., recurring upward movement of salt domes), and other factors. In spite of these slope variations certain differences in the levees of various streams are evident. Nevertheless, the writer does not feel that a quantitative approach to levee comparison is justified.

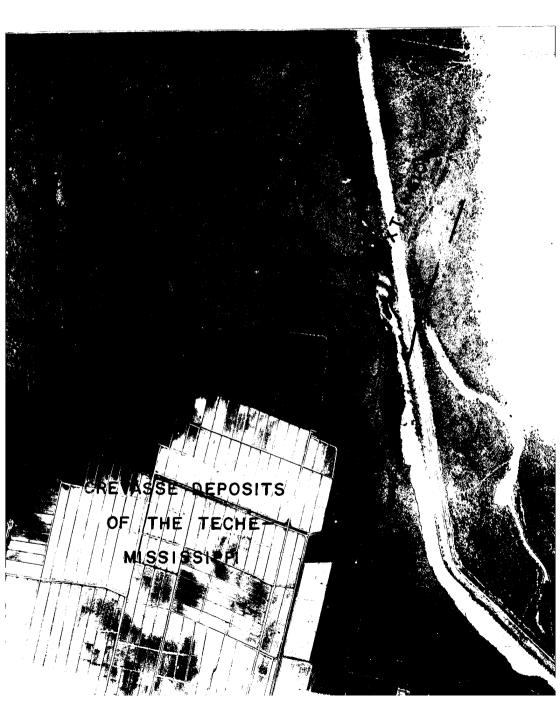
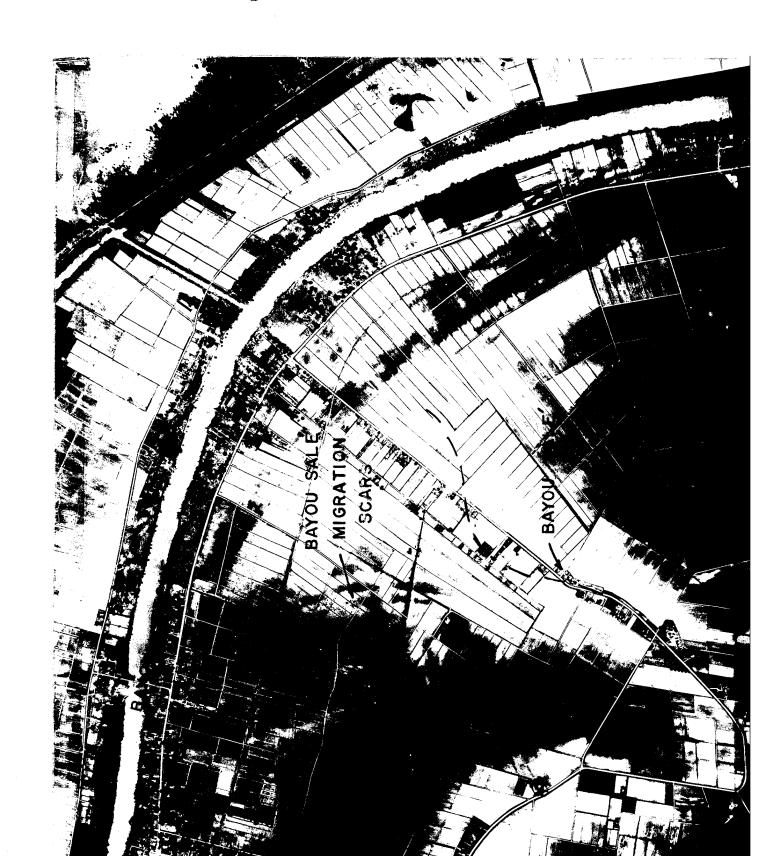


Figure 21 - Sale'-Teche Junction Area



Possum Point (Plate I, Fig. d), where a large partly buried shell midden, overlies oxidized levee material. The width of this buried levee ridge, as reflected in the drainage pattern, is equal to the 0.6 mile average cultivated width of the Bayou Sale' levees. Artificial levees have been constructed skirting the natural levees of Bayou Sale', thus keeping the marsh water from the natural levee flanks and providing more arable land. Therefore, the width of cultivated land is fairly close to the actual width of the Bayou Sale (Teche-Mississippi distributary) levees. Consequently, a marsh-covered levee ridge surficially reflecting, in spite of subsidence, a width comparable to that of the Bayou Sale' levees would, in reality, be broader than the Sale' levees. The levees of the Clausen-Possum Point trend may, therefore, be considered to be of greater proportions than those now flanking Bayou Sale'. There is no increase in width of the present Bayou Sale' levees north of Clausen, thus indicating that the submerged levec ridge was not formed as a distributary of this stream. In addition, it is obvious that levees flanking a distributary would not be broader than those paralleling the trunk stream, unless some subsequent surficial modification has taken place. Thus the Clausen-Possum Point ridge must have been formed previous to the development of the Bayou Sale' branch of the Teche-Mississippi, and is - a priori - probably pre Teche-Mississippi in age.

From Possur Point southward the traces of the trend are less distinct. However, Veatch (1899) has described objects, which would now be identified as artifacts of pre-tchefuncte age, from a site located slightly northeast of Belle Isle, thus suggesting that a stream with habitable levees was flowing in the Belle Isle area during pre-tchefuncte (pre Teche-Mississippi - Fig. 18b) time. On the basis of this cultural evidence the course has been tentatively continued to Atchafalaya Bay (Plate I, Fig. a - stream course 1).

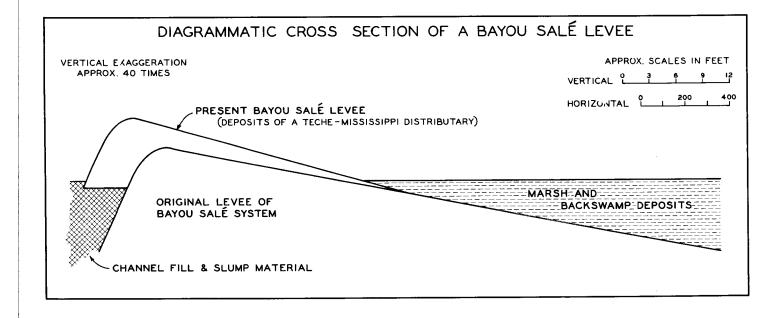
Another ridge of marsh-covered levee apparently diverges from the present Bayou Bale' trend near North Bend (Plate I, Figs. a and d). Its continuation south of the Intracoastal Canal has not been definitely established; however, pre-Tohefuncte artifacts have been reported from Negro Hammock (personal communication - Wm. McIntire). Unfortunately shoreline erosion has destroyed the Negro Hammock site and its submerged remains are presently located almost 300 yards offshore. However, the presence of artifacts washed onto the adjacent beach suggests that an ancient levee-flanked stream existed in the region and, consequently, the North Bend course has been tentatively extended into the Negro Hammock area.

The fact that the broad levee ridees diverge from the Bayou Sale' trend suggests that the present, cultivated

Bayou Sale' levees overlie older similar deposits. A plausible relationship between the present, steep, narrow, levees and the older underlying deposits is presented in Fig. 22.

The main Bayou Sale' trend is undoubtedly continuous to Rabbit Island (Plate I, Figs. a and d). Borings on Rabbit Island encountered levee material at depths varying from two to six feet and indicate that the levee crests are located to the north of the island. Several Indian projectile points, suggestive of pre-Tehefuncts (pre-Teche-Mississippi - Fig. 18b) age, have been found along the shell beach which flanks the northern shore of the island. The projectile points were probably derived from middens located near the crest of the original Bayou Sale' levees (Fig. 22). The subsided levees on which the middens were located were probably partially covered by the steep, narrow levee deposits of the Bayou Sale' distributary of the Teche-Mississippi, and subsequently exposed to wave attack.

Thus it is possible that three pre-Teche-Mississippi courses exist in the Bayou Sale' region. The size of their marsh-covered levees indicates that the streams were more important than the Bayou Sale' distributary of the Teche-Mississippi. Such streams certainly would have formed fairly extensive deltas in areas now covered by the Gulf of Mexico. Shoal areas found off the present shoreline (Plate I, Fig. d) possibly represent the deltaic remnants of the



original Bayou Sale' system (Morgan, Van Lopik, and Nichols, 1953, pp. 6-8). The general outline of these shoals and the fact that they are composed of coarser material than the surrounding bottoms (Carsey, 1950, Fig. 15) certainly suggests a deltaic origin. Furthermore, Price (1954, Fig. 1) has mapped this portion of the gulf as a region of "Submerged Deltas." Thus the identification of the shoal areas as submerged delta masses seems valid.

There is, at the present time, no direct connection between the levee deposits of the mainland and the offshore deltaic complex, however, old maps and charts indicate that the present Bayou Sale' trend previously extended as far westward as Marsh Island and suggest a connection with the Shell Keys area (Plate I, Figs. a and d) to the south. For example, the Admiralty Chart of the Coast of West Florida, and the Coast of Louisiana, 20 surveyed by George Gauld in the years 1764-1771, shows an almost continuous string of island extending from the Bayou Sale' region to the Southeastern tip of Marsh Island. Plate I (Fig. a) presents a tentative correlation of the Bayou Sale' courses and the off-shore deltaic masses.

If the connection between the original Bayou Sale' system and the offshore deltaic masses is accepted, the

²⁰ This chart is remarkably accurate and much better than most coastal maps published as late as 1850.

pre-Teche-Mississippi age determination of the system is strengthened, for it is improbable that a mere distributary of the Teche-Mississippi could have spawned the deltaic areas still discernible off the present shoreline. Acceptance of the pre-Teche-Mississippi age, however, demands the presence of an extension of the Bayou Sale' system to the north of the Teche ridge.

The Teche ridge forms the southern and western boundary of the great Atchafelaya Basin. This basin, which was formed when the low central portion of the Lower Mississippi Alluvial Valley became completely surrounded by natural levee ridges built by various Mississippi River courses (Fisk, 1952), contains many lakes (e.g., Grand Lake, Six Mile Lake, Lake Fausse Pointe) that are remnants of a much larger body of water. The existence of these extensive lakes makes it very difficult to trace the ancient levee systems, northward from the Teche across the low, presently rapidly alluviating, basin. Nevertheless, some evidence suggestive of a continuation of the Sale system north of the Teche levees does exist.

A possible indication of the Bayou Sale' system north of the Teche ridge is found in Cathcart's (1819) work. His map, while not accurate so far as distance is concerned, can certainly be relied upon as to relative positions of various features. Cathcart shows a small bayou running approximately

northeastward from the Teche ridge. This fact in itself is not important for the bayou is probably known on modern quadrangles as the more easterly flowing Yellow Bayou; however, Cathoart (p. 37) mentions that a shell midden is located at the mouth of this bayou. This shell accumulation would, therefore, be located well off the Teche levees and to the east of the large bend in the Teche (Fig. 2), in other words, practically opposite the Sale'-Teche junction. The presence of this midden is suggestive of a more important stream than the insignificant modern Yellow Bayou.

A northward continuation of the Bayou Sale' system is also suggested by the convex-northward bend in Yellow Bayou, which possibly indicates a buried levee ridge. The broad northward bulge in the cultivated area along the Teche in this region is also indicative. Unfortunately, more recent alluviation by the Teche-Mississippi has masked most of the older deposits near the Teche ridge, however, aerial photographs reveal a northward trending tonal band that could easily reflect buried natural levees (Fig. 21). The 1841 meander line (old shoreline) shown on modern quadrangles is also indicative as it shows that the shore of Six Mile Lake has retreated on both sides of this tonal band; whereas, a slight promitory has developed where the band intersects the lake shore. In addition, the fact that the Bayou Sale' distributary branched from the Teche-Mississippi

on the inside of a bend is possibly indicative of a near surface north-northeast to south-southwest trend in the junction area. Normal crevesse channels, which give rise to distributaries of any importance, are invariably formed on the outside of bends.

Bayou Sale' distributary of the Teche-Mississippi was operative there was little chance for a second important discharge channel to develop in the other leves opposite the first. Thus the possibility that a northward trending leves ridge of any length, north of the Teche ridge near the Sale'-Teche junction, would reflect a distributary of the Teche-Mississippi is very remote. Typical short-lived, bifurcating, crevasse channels and their fan-shaped deposits were undoubtedly formed along the northern Teche-Mississippi leves; however, streams of this type usually do not form leves ridges which extend for any distance away from the main course.

Thus evidence seems to indicate an extension of the Bayou Sale' system north of the Teche ridge. Its possible continuation to the northeast of Grand Lake (Plate I, Fig. d) is more difficult to ascertain. A prolongation of the Bayou Sale' system intersects the eastern shore of Grand Lake slightly below the mouth of Big Bayou Pigeon (Plate I, Fig. a). Considering Big Bayou Pigeon to be the northern

extension of the system, though speculative, is certainly attractive. The bayou has broad natural levees that, before man and subsidence took their toll, supported a fine growth of oak. Thus it possesses many attributes of a more important stream than its present degenerate condition indicates. The presence of pre-Tchefuncte artifacts in middens along its levees (Wm. McIntire--personal communication) is an indication of great antiquity. All in all, Big Bayou Pigeon meets the requirements for the extension of the Bayou Sale' system and will be tentatively considered as such in this report (Plate I, Fig. a). 21

Fisk (1952, Fig. 14), as previously pointed out, shows Bayou Sale' as a distributary of his Maringouin system. The Maringouin course, as shown on Fisk's (1952) Figure 14, is not the same Maringouin course presented in his 1944 (Plate 2, Sheet 2) report. In addition, Figure 14 of the 1952 report makes no indication of the Cocodrie course, which was illustrated as subsequent to that of the Maringouin in the earlier work. See Fig. 18b for Fisk's 1944 chronology. Consequently, the only correlation that can be made is to

Bore holes put down on Cypress Island (Fig. 2) and along the western shore of Tiger Island, plus the alignment of a few, scattered, oak trees seem to indicate that the trend of the old stream courses in the area was in a N-S to NNW-SSE direction. In other words, no eastward turning of the Bayou Sale' trend north of the Teche Ridge was found.

conclude that the Bayou Sale' system is a part of Fisk's Maringouin-Cocodric complex.

Plate I (Fig. a) indicates the courses and deltaic areas of the Bayou Sale' system. The earliest courses, 1 and 2, were probably, in part, coeval and undoubtedly received some flow while course 3 was operating as the main channel. (It should be borne in mind that flow down old river courses is not abruptly out off, and that many old channels continue to receive water, particularly flood water, long after they cease to function as main river channels.)

Shorelines are tentatively shown. Several bore holes on western Marsh Island encountered bay bottom sands at a depth of approximately twenty-two feet. The feather edge of this sand layer, which rises and pinches out to the east, possibly approximates the old shore line of the course 3 delta, and was assumed to do so in the figure. The earlier shoreline is purely hypothetical.

From the preceding pages, it is apparent that the Bayou Sale' system possesses a relatively complex history, certain portions of which are still in doubt. Bayou Sale' and Bayou Cypremort, which will be discussed in the following section, have previously received very little geologic attention and it should be emphasized that the material presented in this report is but a start in the interpretation of their respective histories.

Bayou Cypremort

Although the early literature does not abound with descriptions of Bayou Cypremort, a few references have been found. Hilgard (1873, p. 7) mentions the nature and fertility of the soil along the bayou. Dennett (1876, p. 101) in describing the region states:

The road leading through these enchanted forests (Cypremort Woods), along the banks of the bayou, is firm, smooth and sandy. The bayou itself is by no means beautiful, since it is usually filled with rank weeds, rushes, willows and numerous other trees and bushes peculiar to these shallow and narrow bayous. It can in no place be navigated with a skiff.

Perrin (1891, p. 214) observes:

The Bayou Cypremort is lined with beautiful forests, of which the stately magnolia predominates. Many of them over fifty feet high . . . But mingled with the magnolia along Cypremort are oak, ash, black walnut, hickory, sweet gum, pecan, elm, etc., with a rank growth of underbrush and grape vines. There is nothing very beautiful and enchanting in the bayou as a stream, it being filled with weeds, rushes, and willows, a seeming haunt for snakes and other water reptiles.

The same descriptions fit the bayou today, for it has been deepened only near its mouth where a docking area for pleasure boats has been constructed. A narrow band of woods, about four miles in length, flanking the bayou near its mouth is all that remains of the magnificent forests described by the early writers.

References to Bayou Sale' have been found as far back as 1802 (St. Mary Farish Planning Board, 1949, p. 7) while Cypremort, due to its later settlement, received no mention

until 1813 (Survey of Federal Archives in Louisiana, Book I, Part 2, Atakapas Region, 1939). The earliest physiographic descriptions of Cypremort are found in the 1870's, whereas Sale' was described as early as 1819 (Cathcart, p. 98). However, the assumption that Cypremort, like Sale', received no through flow during historic times is valid.

The recent geologic literature is almost completely lacking in references to Bayou Cypremort. Fisk (1944, Plate 15) places the bayou in stage 2 of his chronology, but does not mention it in the text. This stage 2 classification indicates that he considers the stream to be a distributary of the Teche-Mississippi.

That Bayou Cypremort was never a very important stream is attested to by (1) the relatively small deltaic area that can be ascribed to it, (2) the presence of only small buried distributaries in no way comparable with those of the Bayou Sale' system, and (3) the size of its levees (Fig. 19b). The fact that the levees of Cypremort, just south of the Teche ridge, are restricted to a narrow cut through the Pleistocene Frairie Terrace (Fig. 4) indicates that the present levees do not mask a more important stream as in the case of Bayou Sale'.

Bore holes and aerial photographs show clearly that Bayou Cypremort branched repeatedly in the Vermilion Bay area. The extension of the bayou westward from Cypremort

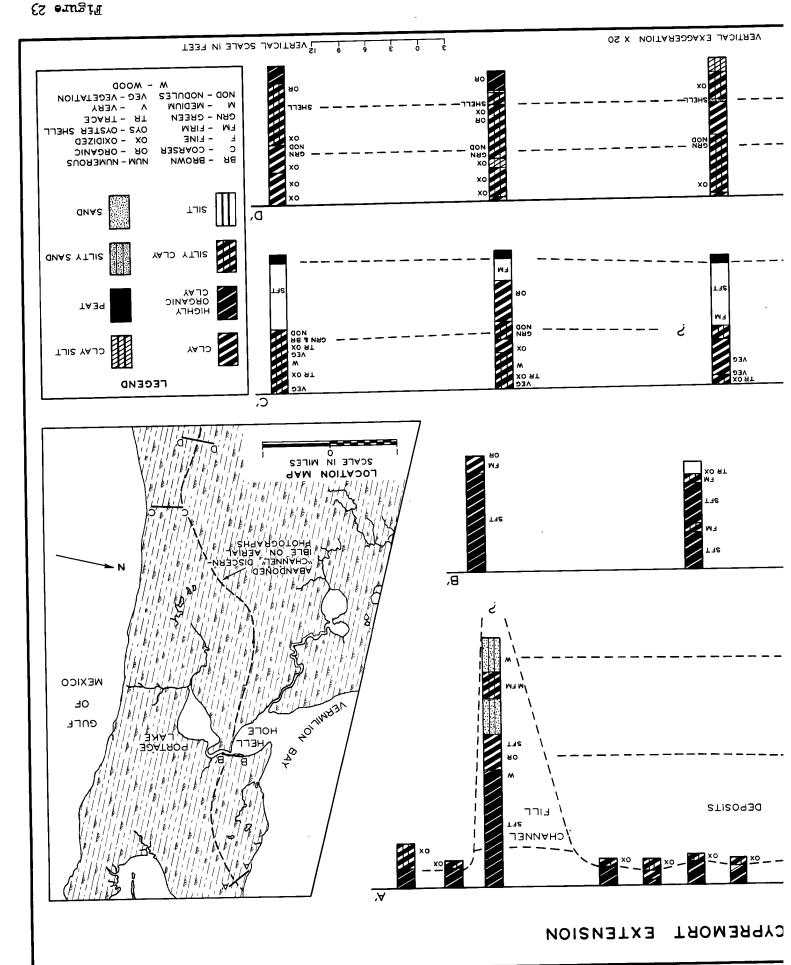
Point is easily plotted by following the shoal area known as Terrapin Reef (USC&OS Chart 1277). This trend intersects the northern shore of Marsh Island about a mile west of the mouth of Bayou Chene. Bore holes put down at the point where this trend intersects the bayou encountered levee material at a depth of three feet. Numerous other small distributaries of Bayou Cypremort undoubtedly cross Marsh Island: however, the exact positions cannot be plotted at the present time. Current work by Edward Orton in this area may provide additional data. Oxidized silty clay, interproted as levee material, found along the southwestern coast of Marsh Island, originally considered to be possible extensions of the Bayou Sale' system (Morgan, Van Lopik, and Nichols, 1953, pp. 6-8) probably belongs, in the light of later field work, to the Cypremort system. However, the evidence is still inconclusive.

The NH-SW trending levees that intersect the south shore of Vermilion Bay approximately two miles east of Hell Hole undoubtedly represent another distributary of the Cypremort system. Fig. 23a shows a bore hole profile of these oxidized levees. The shell-sand bay bottom layer, across which the stream prograded, lies at an average depth of twenty-five feet. This zone may correspond to the bay bottom sands found underlying the western portion of Marsh Island at a depth of twenty-two feet. Note also that the

total width of the oxidized zone for both levees should exceed 3,000 feet. In spite of this fact, numerous holes along the eastern shore of Hell Hole, where the scar can apparently be traced on aerial photographs, reveal only relatively narrow discontinuous bands of oxidation indicative of levee deposits (Fig. 23b). The conclusion that the bayou has bifurcated before reaching Hell Hole is inescapable. Several possible courses suggest themselves from an examination of aerial photographs, however definite field evidence of these courses is lacking.

A smaller branch of Cypremort apparently continues to the west of Hell Hole. However, a well defined tonal band, so distinct on aerial photographs, trending from Hell Hole to the Chenier au Tigre region does not reflect an old channel. Two bore hole profiles (Fig. 23c and d) prove conclusively that, although the region was probably the site of deltaic sedimentation, this tonal band does not overlie levee or channel fill deposits. Traces of several old, northwest trending, shorelines cross the area to the east of Chemier au Tigre, therefore, it is possible that the levees at one time did extend into this region, and were subsequently truncated by shore line retreat. A study of aerial photographs and bore hole information (Fig. 23) indicates that only the very distal portion of the streams or stream reached the Chenier au Tigre region and, therefore, the retreating shoreline did not truncate a levee system of any

CROSS SECTIONS OF A POSSIBLE BAYOU CYPREMORT [MARSH DEPOSITS DEPOSITS LEVEE INTERDISTRIBUTARY DEPOSITS DELTA - FRONT AND BAR DEPOSITS SHELL SEDIMENTS BOTTOM BAY FM GRN M SFT TR OX OYS GRN NOD VERTICAL EXAGGERA HORIZONTAL SCALE IN FEET



magnitude. On the other hand, there is a possibility that the main stream turned southwestward east of Hell Hole. Thus its distal portion would have been truncated by the present shoreline at the Gulf of Mexico (Plate I, Fig. b). Scattered borings were made along the present shore in an effort to locate the point at which (if the above hypothesis is correct) the leves would have been truncated by the present gulf shore; however, no evidence of this possible southern extension was found.

There are some data suggesting that Cypremort is younger than the Bayou Sale' system. A boring made near Mound Point, Marsh Island, encountered well preserved wood fragments and logs at twenty-five to twenty-nine feet, after passing through approximately four feet of compact peat. This sequence suggests a relative subsidence of the land with the woody zone possibly representing the back swamp region of the Bayou Sale' system, formed as Sale' (Course 3, Plate I, Fig. a) prograded westward across the embayment which formerly existed in the Marsh Island area. Several borings on the eastern half of Marsh Island reveal a rather irregularly occurring sand layer at approximately twenty-six feet, which possibly represents the bottom of the embayment. Additional borings indicate that this layer is not continuous with the twenty-two foot sand which underlies the western half of the island. As previously pointed out, Bayou Cypremort probably prograded across a continuation of the

twenty-two foot sand, thus, it is suggested that Cypremort, by its stratigraphic position, is younger than Sale! A sufficient number of borings is not available to allow definite correlation between the Hell Hole, Marsh Island, and Bayou Sale! areas and, thus unreserved acceptance of the above hypothesis is impossible. Further field work with this stratigraphic relation in mind, however, may prove edifying.

It is also interesting to note that at only two localities in central coastal Louisiana have Indian projective points been found. One of these sites lies about two miles east of Hell Hole on levee deposits of Cypremort origin; the other is a beach accumulation, located on Rabbit Island, overlying levees of the Bayou Sale' system. The projectile points are suggestive of pre-Tchefuncte age. The facts that pre-Tchefuncte artifacts have been found on courses 1 and 2 (Plate I, Fig. a) of the Bayou Sale' system; projectile points have been found on course 3 of the Bayou Sale' systen; and projectile points and Tchefuncte potsherds have been found along Bayou Cypremort suggest a gradual westward movement of deltaic sedimentation. It is also apparent that after the formation of the deltaic area to the southwest of Marsh Island the most logical region for further sedimentation would be in the delta-flank depression north of the Bayou Sale' delta, and south of the Pleistocene outcrop--a position occupied by Bayou Cypremort. The preceding

discussion, of course, still leaves the relative ages of Cypremort and Sale' somewhat in doubt. However, available data seem to indicate that Cypremort is definitely younger than the 1 and 2 courses of the Bayou Sale' system and probably younger than course 3 (Plate I, Fig. a). The concept that Cypremort and course 3 of the Sale' system were, in part, coeval, although doubtful, cannot be discarded. The writer has ignored this possibility only because there are no facts available, at the present time, to support this contention. This lack of evidence, of course, in no way disproves the theory. The finding of projectile points on the extension of Cypremort near Hell Hole suggests that by preor early-Tchefuncte time the stream was well established and flanked by habitable levees. If the chronologies established by Fisk and Phillips, Ford, and Oriffen (Fig. 18b) are accepted the Teche course was not established until Tchefuncte time, thus suggesting that Cypremort is older than the Teche-Mississippi. Furthermore, there is apparently an extension of Bayou Cypremort to the north of the Teche ridge. Fig. 24 shows the almost perfect alignment of Bayou Cypremort with this northward projecting finger of high ground which can be traced to the southern shore of Lake Fausse Fointe. Bayou Cypremort had originated as a distributary of the Teche-Mississippi River it is highly improbable that a similar distributary would form on the opposite side of the



Figure 24 - Cypremort-Teche Junction Area



river. Profiles of the northward trending oxidized levee ridge (Profiles 1 and 2, Figs. 19 and 20) indicate that it has been partially destroyed by erosion. This modification is probably the result of wave action at a time, previous to the breaching of the Teche-Mississippi ridge by waters of the Atchafalaya Basin, when Lake Fausse Pointe was more extensive than at the present time.

It should be pointed out, that accepting the preTeche age of Cypremort does not imply that there was no
Teche-Mississippi flow down the bayou. In fact, well preserved crevasse patterns are discernible on the Cypremort
levees thus suggesting through flow during Teche-Mississippi
time (See Teche-Mississippi section for further discussion).

Connecting Cypremort with its trunk stream north of lake Fausse Pointe presents somewhat of a problem as more recent sedimentation in this area has masked the earlier stream courses. The only suggestion that can be made at the present time is that Bayou Sorrell forms the northern continuation of Cypremort. This supposition is based entirely on cultural evidence which suggests that Bayou Sorrell is the same approximate age as Bayou Cypremort. (Wm. McIntire has found Foverty Point artifacts along Bayou Sorrell - personal communication).

Plate I (Fig. b) attempts to summarize the available information on Bayou Cypremort, showing its original course,

branches, deltaic area, and the relative position of the shoreline at that time. Bayou Sorrell is tentatively considered to be the prolongation at Cypremort north of Lake Fausse Pointe.

Before concluding this section mention should be made of the modifications affected in the levees of Bayous Cyprenort and Sale' by novement along the Five Island fault zone. As Morgan, Van Lopik, and Nichols (1953, p. 4) have pointed out, "The presence of this fault has not been definitely established, but is suggested by several lines of evidence: (1) the specific orientation of all five of the salt domes, (2) narrowing of the natural levees of Bayou Sale' south of Gordy, Louisiana, and (3) narrowing of the natural levees of Bayou Cypremort at the town of Cypremort, Louisiana." Profiles 8, 9, and 10 (Fig. 19) graphically illustrate the effect on Cypremort levees of the relative downdropping of the land southwest of the fault. These facts attest to the recency of movement along this fault zone, in addition, other data indicate that the salt masses forming the core of the Five Islands are still rising. Weigelt (1927; p. 47) makes the following observation (translated from the German), ". . . their (the Five Islands) young uplift becomes documented by the fact that the rock salt, in spite of the moist climate, comes up nine meters above the present surface." Weigelt's observation in regard to the effect of climate on

the salt is well founded for there can be little doubt that under arid conditions the Five Islands would give rise to phenomenal salt mountains and glaciers such as are found in Iran today. Thus, the truncation of the levees of Bayous Cypremort and Sale', and the elevation of pure salt about twelve feet (Weigelt's nine meter figure is slightly high) above the present surface, in the moist climate of Louisiana, certainly attests to the recency of activity along this trend.

Bayou Teche and Vermilion

The regions most important artery of travel during the early days was the well-known Bayou Teche. Thus, the logical early habitation sites were on the levees of this bayou, and consequently, by 1800 most of the land flanking Bayou Teche had been surveyed.

Indeed, the importance of water navigation in the settlement of the region cannot be overemphasized, and it is not surprising that the early descriptions of the area focused along Bayous Teche and Vermilion. The fact that early navigation along these streams was not ideal is pointed

²² Surveyor's plates, surveyed about 1800 and now on file at the Louisiana State University Department of Archives and Manuscripts, of the present Arnaudville region show the width of Bayou Teche as 175 feet. A maximum estimate of its width today is approximately 125 feet. Bayou Fusilier is shown as approximately 130 feet in width, indicated it was functioning as a distributary of the Teche, a position it fulfills today only during extreme floods.

out by Sibley (1803, p. 50) who states:

There is likewise a small coasting trade between the Atacapas and Opelousas, and New Orleans, by way of the Balize, which would increase, if there was any encouragement given by the government, to clear away a few obstructions, chiefly caused by fallen timber, in the small rivers and creeks leading to them.

Later works by Robin (1807), Darby (1818), Cathoart (1819), Flint (1832), Duncan (1850), Brent and Hebert (1856), Hilgard (1873 and 1884), Hoffman (1881), Collins (1881), Perrin (1891), Quinn (1896), Lipsey (1918), Cline (1927), combined with the recent Reports of the Chief of Engineers, U. S. Army, allows a fairly complete picture to be drawn of the Bayou Teche and Vermilion history, during the last 150 years. Such a review of the literature gives rise to the following observations: (1) Bayou Teche is but the spectre of a former, greater stream; (2) were it not for man's intervention, the present channel of Bayou Teche would be in an advanced state of deterioration; (3) two distinct sets of natural levees flank Bayou Teche; and (4) the Vermilion River functioned as a distributary of Bayou Teche until fairly recent time, and still serves in this capacity at extreme flood stage.

Recent geologic investigations have tended to confirm the above mentioned observations. Howe and Moresi (1931 and 1933, p. 31) state:

At the present time Bayou Teche is a comparatively small stream imprisoned between gigantic natural levees.

We have already noted that these levees are comparable in size to those of the present day Mississippi River. appears evident that a stream the size of the present Bayou Teche could not have formed such levees. it a pear possible that they could have been formed by the Red River for they are composed of material quite distinct from that carried by the Red River. It is now reasonably well known that the course of Bayou Teche was occupied by Red hiver within the past thousand years. The record of this occupation appears in the narrow strip of typical Red River sediment which flanks Bayou Teche That Red River was a much within the levees themselves. smaller stream than the one which formed the great levees flanking Bayou Teche is clearly shown by the fact that the Red River sediment does not reach to the top of the levees and is not found on the outside of the levees except where distributaries such as Catahoula Coulee or Bayou Fuselier occur. The sudden appearance of the great levees of Bayou Teche rising out of the swamps of the delta in St. Landry Parish show that they are but remnants of a much more extensive natural levee system. The present Bayou Teche may be considered a sort of relict stream. . .

Russell (1939, p. 1208) concludes:

the course followed by Bayous Wauksha, Courtableau, and Teche as an abandoned Mississippi River channel. It is also apparent that the course followed by Bayous Bouef, Courtableau, Carron, and Mariecroquant belongs to another stream. That this stream is Red River may be demonstrated readily by tracing Bayou Boeuf continuously upstream to the vicinity of Alexandria, where it joins the existing Red River channel. In the field, the contrast is striking between the gray sediments of the old Mississippi levees and the bright red levees of the Red. The line of Red River levees extending down Bayou Boeuf may be traced without interruption to a position between Mississippi levees along Bayou Teche. . .

Fisk (1944) opines that the Teche segment was first occupied by the Mississippi River following J time (see Fig. 18b) and that the pilot channel of this newly diverted Mississippi was probably the channel of the combined Hed and Arkansas river, which were flowing to the Gulf in independent

courses along the western valley wall. Fisk (1944) also believes that during stage 4 the Mississippi abandoned the Teche channel leaving the combined Red and Arkansas in occupancy. The Arkansas soon left the Teche and rejoined the Mississippi, and by stage seven the Red no longer flowed within the Teche-Mississippi course.

Field evidence supports the above mentioned hypothesis. Figure 19a shows the relationship of the Teche-Mississippi and Red levees to the Frairie surface. Note that the two sets of levees are readily discernible. Furthermore, at some locations a third set of narrow levees, those of the present Bayou Teche, can be found inside the Red River levees flanking the present stream. The cultural evidence presented by McIntire (1954, p. 77) indicates that the Teche-Mississippi course was abandoned by the river prior to Marksville time and that the Red occupied the Teche course during the Marksville period. These data agree with Fisk's interpretation (Fig. 18b).

Borings in the area between the Teche-Mississippi and Red levees flanking Bayou Teche suggest that the abandonment of the Teche course by the river was a relatively slow process as there is no abrupt change in sediment color, but rather a gradual transition to the almost pure red coloration of the Red levees.

Field evidence also supports the premise that the

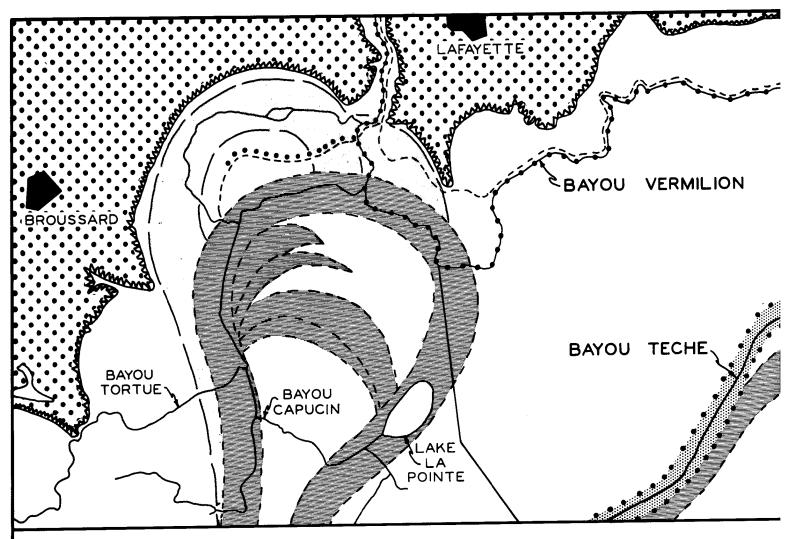
Vermilion River functioned as a distributary of the Teche-Red, in fact, of the Teche-Mississi, pi. From Lafayette almost to Vermilion Bay the Vermilion River follows the abandoned channel of a Pleistocene Mississippi River (Fig. 16). The presence of this confining trough made it possible for the Vermilion to traverse a band of Prairie upland approximately thirty miles in width and explains the absence of well developed natural levees along portions of its channel south of Lafayette. From its junction with Bayou Teche (Fig. 25) the stream traces a serpentine path, controlled primarily by relict meander soars of early Teche-Mississippi courses, until it enters the Frairie Terrace at Lafayette. Fortions of these early Teche-Mississippi courses are easily discernible on aerial photographs. A few traces of the Red-Arkansas meander belt are also distinguishable on aerial photographs as meander scars, and cuspate indentations in the Prairie escarpment. These features are of a size not comparable with similar forms associated with the Teche-Mississippi.

Fisk (1944, Plate 15) indicates that Bayou Vermilion functioned as a stage 3 distributary of the Teche-Mississippi. Furthermore, in the text Fisk (1944, p. 42) observes, "The Vermilion River at Lafayette, La., probably served as a distributary of the Mississippi for the first time during this stage (Stage 1)." Reconnaissance field

work, plus careful examination of aerial photographs, of the complex region between lafayette and Arnaudville enables the present writer to corroborate, to some extent, Fisk's views and present a more detailed picture of the evolution of the Upper Vermilion River.

In all probability local rainfall drainage maintained a stream within the gulfward portion of the Pleistocene meander sears, southwest of Lafayette (Figs. 2 and 16), long before the Teche-Mississippi flowed into the Lafayette-Arnaudville region. Slight headward erosion by this stream probably took place; however, it did not, subsequently, tap the Teche-Mississippi drainage system through this process alone. Crevassing of the Teche-Mississippi levees was also necessary. This crevassing possibly occurred during Stage A (Fig. 25), 23 but more probably during Stage B, thus giving rise to the ancestral Vermilion River whose course is indicated by the dashed line. The upper course of the present Bayou Vermilion, between Bayou Fusilier and Lafayette, existed as a backswamp tributary stream during Stage B. The upper portion of Bayou Vermilion first received flow from

²³ Stages A and C depicted in Figure 25 do not correspond exactly to Fisk's Stages 1 and 2 as shown on Flate 15, Sheet 4 (Fisk, 1944), therefore, Fisk's terminology was not used. Nevertheless, in a general sense Stages A, B, and C may be considered to approximate Stages 1, 2, and 3 of Fisk's chronology.



EVOLUTION OF THE UPPER VERMILION RIVER (SEE TEXT PAGE 128)

A EARLY COURSE OF TECHE - MISSISSIPPI

B LATER COURSE OF TECHE - MISSISSIPPI

DISTRIBUTARY & BACK SWAMP DRAINAGE DURING THIS STAGE

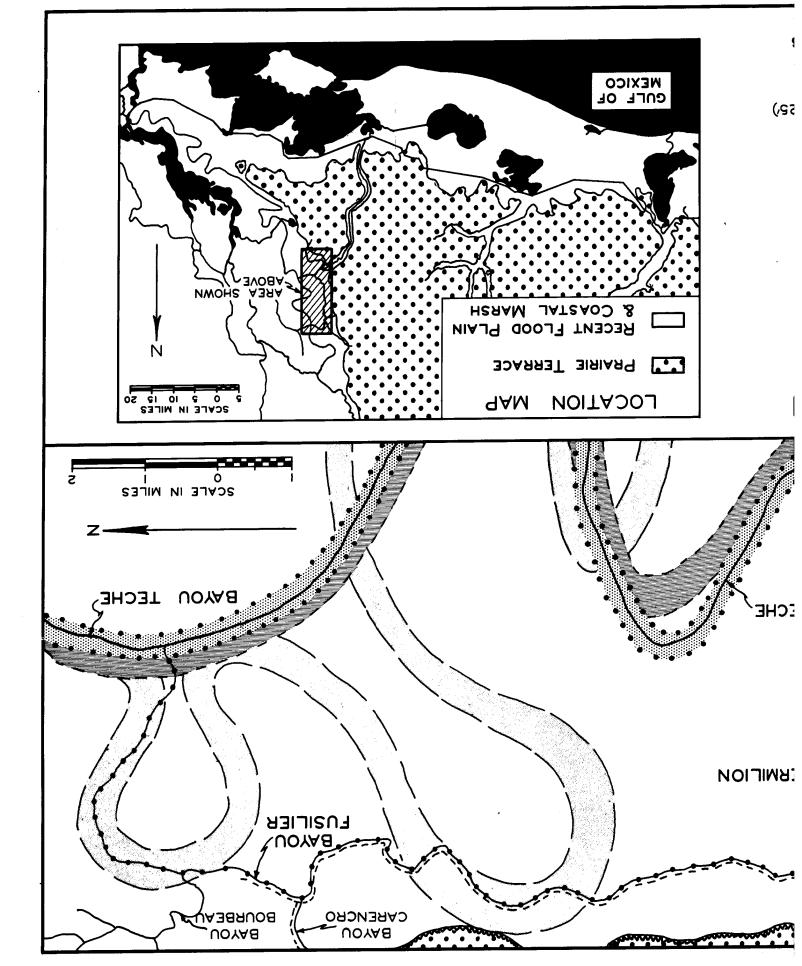
C LAST COURSE OCCUPIED BY THE TECHE - MISSISSIPPI

DISTRIBUTARY & BACK SWAMP DRAINAGE DURING THIS STAGE

DRAINAGE OF THIS STAGE STILL IN EXISTENCE AT THE PRESENT TIME

ADDITIONAL PRESENT - DAY SCARP (APPROX. 25')
DRAINAGE

PRAIRIE TERRACE BACK SWAMP & LEVEE DEPOSITS



the Teche-Mississippi during Stage C. During this stage a crevasse occurred in the Teche-Mississippi levees near the present Teche-Fusilier junction, pouring water into an earlier (Stage A) Teche-Mississippi meander scar (Fig. 25). However, the waters breached the confines of the old scar and merged with the backswamp drainage system, thus enabling a typical short-lived crevasse channel to develop into a more permanent distributary stream.

It is interesting to note that the levees along Bayou Fusilier, near its junction with the Teche, are of the same height as those of the Teche-Mississippi, thus making it obvious that, even though most of the levee material found along the Vermilion is reddish in color, the Vermilion was formed previous to the abandonment of the Teche course by the Mississippi. Thus, the Vermilion has functioned as a distributary of the Teche-Mississippi, Teche-Red, and, until less than 200 years ago, Bayou Teche. Consequently, the sediment load carried by this stream has been subject to great variations during its very early history, a point that should be borne in mind when discussing sedimentation near its former mouth (See section on shoreline changes and chemiers).

Tracing the former channel south of the present mouth is not an easy task. As previously mentioned, throughout its central section the river is controlled by a Pleistocene

Mississippi meander pattern (Fig. 16). An effort, therefore, was made to trace this meander pattern southward from the point where it disapperas beneath the Recent sediments. Accurate contouring of the highly irregular, buried Pleistocene surface with a limited number of borings is almost impossible. Nevertheless, after plotting over 100 bore holes, from various sources, and carefully studying aerial photographs of the region, an attempt was made to contour the marsh-veneered Pleistocene surface and to establish the southern extention of the Vermilion channel (Fig. 26). 24 The data indicate that the Vermilion River leaves the Pleistocene meander belt in the vicinity of the Intracoastal Canal and follows a more southwesterly course (Fig. 16). The trough in the Fleistocene surface (Fig. 26), along this former course, was undoubtedly formed in part by Vermilion River scour. However, a depression of some sort, which controlled the course of the stream, was probably in existence previously.

The southern continuation of the Vermilion River (Plate I, Fig. c and Fig. 26) has been established on the

cases, open to question; however, the figure are, in many cases, open to question; however, the figure is based on more information than any other previously published contour map of the area. The existence of the NE-SW trending trough, between Vermilion Bay and Belle Isle, seems definitely established. The prolongation of this trough to the southwest is very conjectural. Bore holes put down by Edward Orton near the mouth of Rollover Bayou, in Cameron Parish, indicate a Fleistocene valley which could possibly be the continuation of this trough.

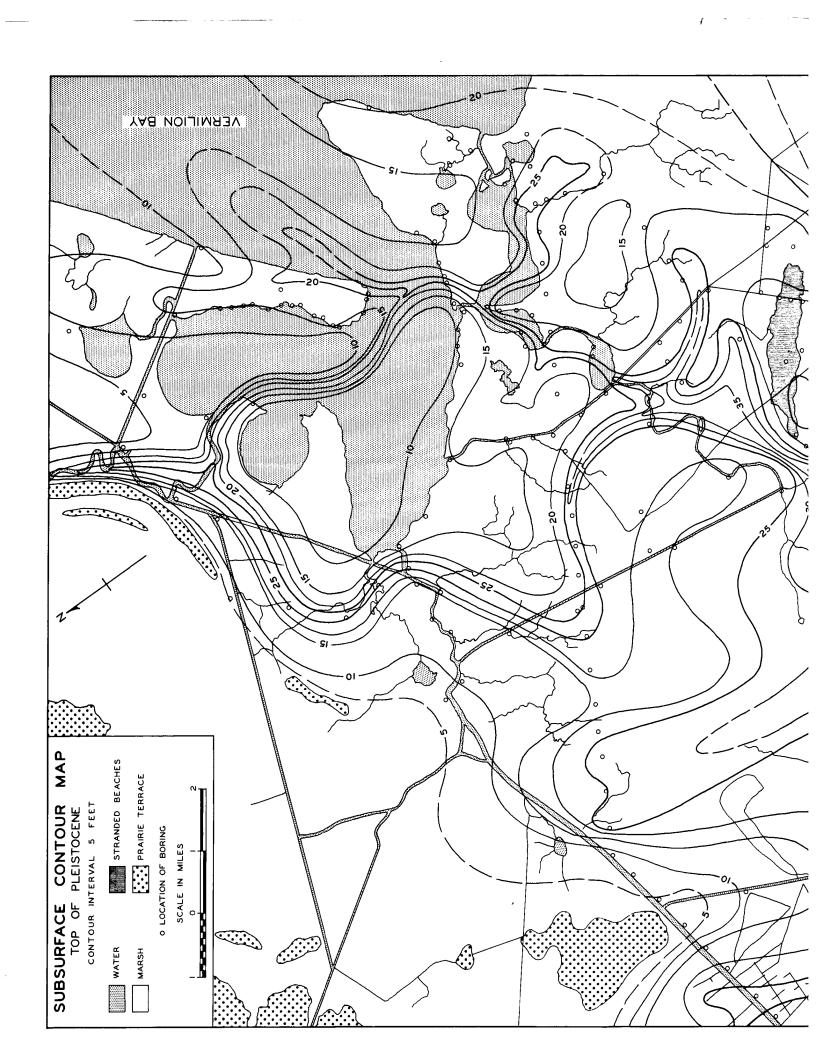


Figure 26

basis of several factors. Bird Island, which was completely removed by dredging about ten years ago, formerly was located about one-half mile off the present mouth of the river in Vermilion Bay. This island, which was originally a high area situated on the left bank of the river, consisted of midden material (primarily shell) in which much Indian pottery was found. Closely spaced bore holes along the extension of land, leading to Mud Point (Fig. 26), opposite the mouth of the river reveal that the channel did not extend southeastward into this region. To the south it is noted that the Belle Isle Bayou-Belle Isle Lake-One Mile Bayou pattern is certainly not typical of marshland drainage (Fig. 2), but rather is more closely allied to that of the Vermilion River. In addition, bore holes indicate the presence of a trough cut in the Pleistocene surface trending SW from the northern entrance to Fearman Lake. Hence, it seems reasonable to assume that the Vermilion followed this trend to the NW corner of Belle Isle.

At the time of the first Teche-Mississippi flow down the Vermilion the shoreline probably paralleled the Back Ridge-Belle Isle-Chenier au Tigre trend to the north and northeast (Plate I, Fig. c). The stream erratically prograded across the shallow embayment, bounded by the above mentioned shoreline, and possible traces of its channel can be found on aerial photographs running to the west of Belle

Isle. Sediment discharge in this area probably provided the material that subsequently, through shoreline retreat, formed Belle Isle. (Shoreline changes are discussed in the following section.)

However, the Vermilion kiver, south of Abbeville, never carried a large percentage of Teche-Mississippi flow. Evidence of this fact is obvious from the absence of well developed levees near the present mouth of the stream, and the lack of any extensive delta near its original distal end (Belle Isle region -- Plate I, Figs. o and d). There is a definite possibility that the greatest portion of the Vermilion flow followed the other set of Pleistocene Mississippi meander scars (Plate I, Fig. c and Fig. 16), southwestward from Abbeville. The meanders are truncated by the northeastern shoreline of White Lake; however, the trend. now marsh covered, probably continues to the southwest of the lake. The alignment of the chemiers, southeast and west of White Lake (Fig. 16), indicates that during the time of their formation a "V" shaped extension of land protruded into the Gulf from the southwest corner of the present lake. This extension was destroyed during the period of shoreline retreat which resulted in the formation of Fecan Island (Front Ridge) (Fig. 2). Although the writer has completed very little field work in this area, he feels that physiographic evidence suggests the existence of a fairly important stream, flowing southwestward from the general vicinity of Abbeville to the Gulf, during a portion of the early Vermilion history (Plate I, Fig. c).

As previously mentioned Bayous Cypremort and Sale also functioned as distributaries of the Teche-Mississippi. When the combined Red-Arkansas River first flowed into the area, paralleling the western wall of the existing Mississippi Alluvial Valley. 25 its path was barred by the previously formed levee ridges of Cypremort and Sale'. Although Bayou Cypremort was a relatively minor stream, its levees, formed subsequent to those of Sale' and thus less affected by subsidence, probably formed the main obstacle to Red-Arkansas flow. Water was impounded to the northwest of this ridge and subsequently breached it within a short period of time. The existing western valley wall had a funneling effect on the drainage of the region and thus aided, by concentrating water near the intersection of its trend with the Cypremort levees, the breaching process. The slightly deteriorated channel of Bayou Cypremort was undoubtedly occupied by a distributary stream at this time. When the

²⁵ The valley "wall" at this time (Plate I, Figs. a and b) consisted of a series of Prairie Terrace promontories projecting into the "sea" of Recent alluvium. The embayments, flanking the promontories, represented the headward portions of the troughs which were created during the late disconsin glaciation (Fig. 15a), when sea level was lowered by approximately 400 feet.

rupture was completed the stream continued southeastward still flanking the western valley wall, which, in this section, had very little surficial expression. The older, more subsided natural levee ridge of the Bayou Sale' system presented a lesser obstacle than that of Bayou Cypremort. Breaching rapidly occurred and the youngest (least deteriorated) channel of the Bayou Sale' system (Plate I, Fig. a, course 3) was occupied, in part, by a distributary stream.

Subsequently the Mississippi diverted into the area; occupying the Red-Arkansas course and, through lateral planation, forming the present western wall of the Mississippi Alluvial Valley. Bayou Cypremort served as a distributary for a short time, however, as the angle of divergence from the main stream was almost 90°, 26 it was rapidly sealed off. The Sale' distributary diverged at a more favorable angle and it is obvious from the accretion pattern found in the region (Fig. 21) that the stream, although sealed off before the Red River occupied the Teche course, 27

Russell (1936, pp. 95-97 and 103) has shown the validity of the concept that large angles of diversion result in rapid scaling off of a distributary; whereas, low angle diversion channels tend to be maintained.

²⁷ Several bore holes put down at various places along Bayou Sale, and Cypremort failed to reveal any red sediment, thus suggesting that by the time the Teche channel was occupied by the ked these streams were not receiving uninterrupted flow. With the exception of the Vermilion River, this statement can be applied to all the Teche-Mississippi shown on Plate I (Fig. c).

received flow for a considerable length of time.

Other distributaries (Plate I, Fig. c) of the Techs-Mississippi are found in the region. The course running due south from New Iberia was recognized, on the basis of soil types, by Mann and Kolbe (1912) and later mentioned by Howe and Moresi (1931). Borings along the Intracoastal Canal at points seemingly on the trend of the distributary, as determined by an examination of aerial photographs, failed to encounter levee material. However, the borings are relatively widely spaced and the writer cannot irrevocably state that a stream of some magnitude did not flow through this region. The course trending south from Franklin (Plate I, Fig. c) is the remnant of a fairly large distributary as indicated by the size of the levee ridge.

In conclusion, the data presented on the preceding pages suggest the following post Sale'-Cypremort sequence of events. Subsequent to reduction in flow, caused by a redirecting of Mississippi flow to the eastward, and partial deterioration of the Sale', and, to a lesser extent, Cypremort channels, the combined Arkansas and Red Rivers diverted into this area along the existing western wall of the Mississippi Alluvial Valley. At this point Sale' and Cypremort probably functioned as tidal streams. The funneling effect of the valley wall aided in breaching the levee ridges of Cypremort and Sale'. The channels of Cypremort and Sale'

were probably both occupied by distributary streams at this time. Later the Mississi pi diverted into the region and occupied the channel previously established by the Red-Arkansas. The Vermilion distributary was created and Bayous Cypremort and Bale' served in a similar capacity. Over-topping of the banks led to the formation of the sizeable natural levees which are so apparent today. Gradually, however, the river was diverted from the Teche course, leaving the Red, trapped between oversized levees, in possession of the channel created by the Mississippi. The Red River, in turn, flanked itself with levees and sent a red finger of similar material gulfward along the Vermilion. Subsequently, the Red too relinquished the channel and today the humble Bayou Teche flows between the double set of natural levees, to the Lower Atchafalaya River.

SHORELINE FLUCTUATIONS AND THEIR SIGNIFICANCE AS INDICATED BY THE CHEMIERS OF VERMILION PARISH

The arcuste series of stranded beach ridges and chemiers found in the coestal marshlands of Vermilion Parish received little mention in the early literature. However, an article appearing in De Bow's Review (Vol. 8, 1850, p. 95) describes Chemier au Tigre as ". . . a strip of high land, between three or four miles long, and from one and a nalf acre to three-quarters of a mile wide, thrown up on the margin of the Gulf of Mexico."

Hilgard (1884, p. 162) observes:

ous ridge in the marsh, about seven miles from the beach. This is densely timbered with pecan trees, and, besides the nuts of this tree, has produced sea-island cotton, also cane, and tropical fruits in abundance, the soil being a rich black loam of great depth. . . Petite Cheniere Island (Chenier au Tigre), on the coast east of Pecan Island, is similar in its character and production.

perrin (1891, p. 247) makes this comment on the cultural level attained by the residents of Pecan Island, "It is inhabited by hogs, cattle and people, and it is said that the latter know little more than the animals with which they live."

The importance of the firm, well drained, chemiers as habitation sites in the marsh is obvious. Geologically speaking the chemiers are equally important. Their significance

is aptly summarized by Russell (1935, p. 54) who states:

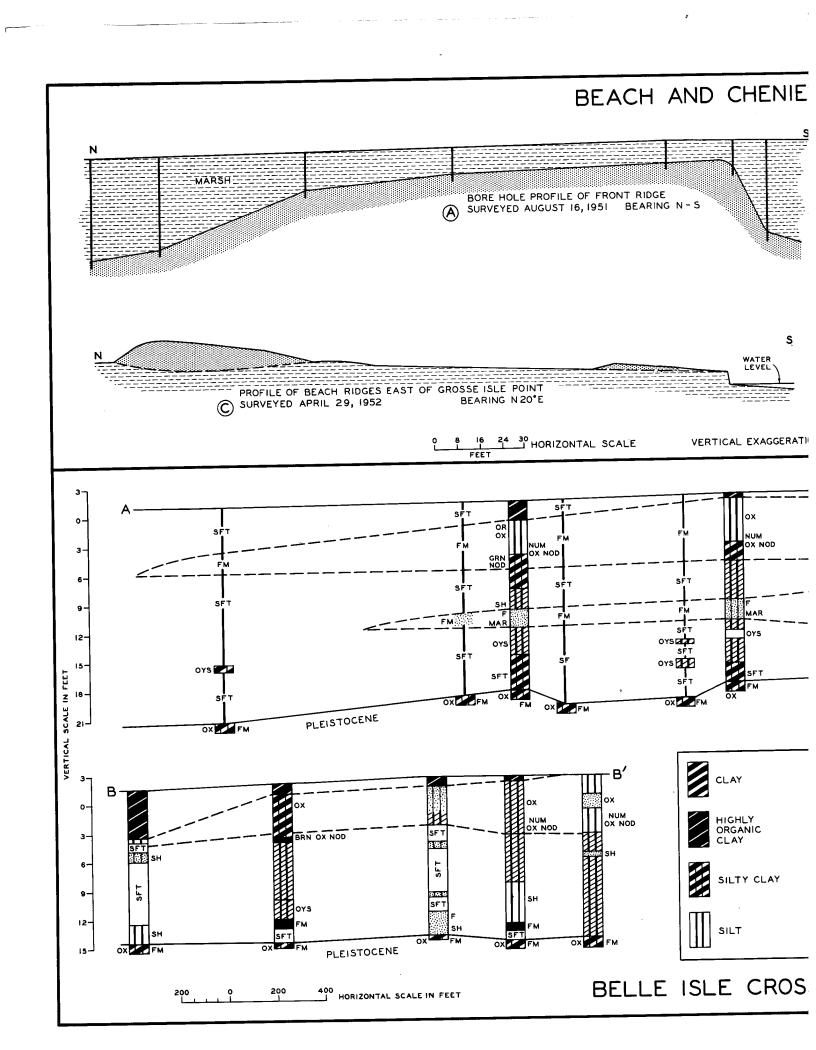
The coastal marshes originated during periods when the Mississippi River discharged west of its existing mouth. Periods of eastward discharge occurred at times and allowed the shore to retreat. Beaches were formed under such conditions. When westward discharge again occurred the coast advanced into the Gulf leaving the most recent beach stranded inland, becoming a chenier. Subsidence, due to the increasing weight of the Mississippi Delta, occurred throughout the whole history of marsh growth and is still in progress. The highest cheniers and least flooded marsh are nearest the existing coast for the reason that the marsh there is youngest and here suffered least submergence.

Consequently, each chemier marks a period of coastal retreat between two periods of advance. This process is operative today along the coast of Vermilion Parish. Due to increasing discharge and sediment carrying capacity of the Atchafalaya River a growing area of active sedimentation has been established approximately 125 miles westward of the present Mississippi mouth. This influx of sediment has accelerated the formation of mudflats along the Vermilion Parish coast, stranding the present beaches, and thus creating new chemiers.

Although the above mentioned process adequately explains the major chemier systems, other more local changes in sedimentation undoubtedly were important in forming the smaller chemier groups. For example, stranded ridges occur near the mouths of formerly estuarine streams such as the Calcasieu and Sabine Rivers in Cameron Parish. The arrangement of these river mouth chemiers, divergent toward the

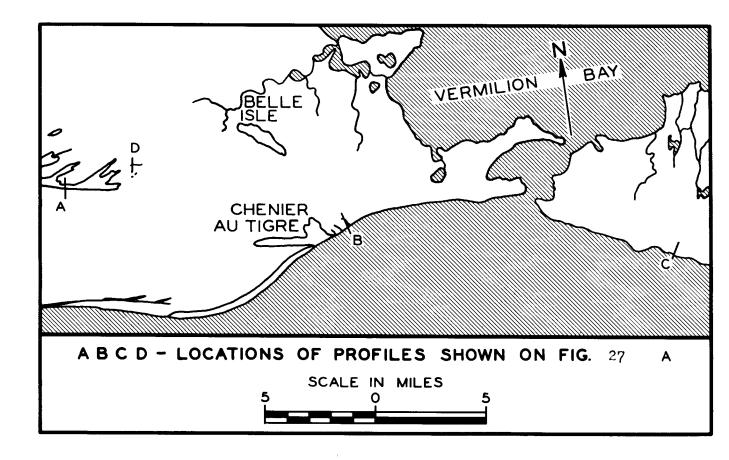
river and convergent along the coast away from the mouth, indicates that their formation was dependent upon fluctuations in local conditions and not controlled by shifts of the Mississippi mouth. It is interesting to note that similar river mouth chemiers found in Surinam apparently diverge away from the river mouth (Brouwer, 1953), thus resembling extremely large river mouth spits. The difference can probably be explained by a more powerful longshore current along the Surinam coast; in any event, further study will result in many interesting comparisons between the chemiers of Southwest Louisiana and Surinam.

Local conditions modify the shape of the beaches and hence, the resulting chemiers. Usually the typical chemier exhibits a relatively steep gulfward slope and a gentle landward inclination (Fig. 27a, Profile A); likewise, modern beaches, open to direct attack of the Gulf waves, display the same slope relationships (Fig. 27a, Profile B). However, smaller present-day beaches flanking shallow embayments protected from direct wave attack by coastal configuration or a favorable arrangement of offshore reefs exhibit gentle gulfward slopes and relatively steep landward slopes (Fig. 27a, Profile C). The concentric arrangement of a series of chemiers (Pecan Island-Belle Isle-Chemier au Tigre) found in Vermilion Parish (Fig. 2) suggests that they were formed flanking a protected embayment. If this is



SEE FIG.28 FOR LOCATIONS

CHENIER PROFILES



true, most of the chemiers of this series should exhibit a gently sloping gulfward surface. (This generalization applies only to the concentrically arranged chemiers and excludes such forms as Front Ridge of Pecan Island and the E-W trending portion of Chemier au Tigre.) The easternmost ridges of both Chemier au Tigre and Front Ridge (Fig. 27a, Profile D) display gently sloping gulfward faces and relatively steep landward slopes. Belle Isle presents an almost symmetrical cross section, having gentle gulfward and landward slopes (Fig. 27b).

Cheniers of this type probably represent minor shoreline fluctuations in protected embayments; whereas, the steeply-gulfward-sloping variety denote a major retreat of the gulf shoreline. The above statement is, of course, a generalization; however, it seems to be valid in this particular coastal area and leads the writer to believe that only two chenier trends (Front Ridge and the E-W ridge of Chenier au Tigre) can be definitely correlated with shifts of the active delta of the Mississippi River.

Figure 29a and b summarizes the effects of the river sequences proposed by McIntire (1954) and Fisk (1944) on the coastline of Vermilion Parish. The relative position of the active delta with respect to the 90° W meridian of longitude has been noted for each river course. Most of the former deltas fall, in their entirety, either west or east of this

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90° meridian, thus making it a convenient, though arbitrary, dividing line. Ancient rivers with outlets to the west of this line undoubtedly gave rise to mudflat and marsh formation, thus creating stranded beaches or chemiers along the Vermilion Parish coast; whereas, rivers debouching to the east, led to beach formation, through shoreline retreat, along the coast of this parish. An exception to the above statement is found in the present Balize delta which projects southward far enough to allow portions of its discharged sediment to reach Vermilion Parish by utilizing the westerly currents. It should also be noted, that the amount of sediment discharged into the Gulf through the Grand River-Belle River channels, which breached the Teche ridge, was probably small. Nevertheless, this material reached the Gulf westward of the 90° W meridian of longitude.

The major eastward deltaic shift in Fisk's chronology (Fig. 29b) occurred when the river diverted from its Lafourche course to the Metarie channel. It is thus logical to assume that the major shoreline retreat, represented by Front Ridge in Vermilion Parish, began, according to Fisk, after the river left its Lafourche course, and continued during the time the Metarie, La Loutre, and River aux Chenes channels were occupied. Subsequent to the formation of Front Ridge, a very slight shoreline advance possibly occurred in Vermilion Parish with the occupation of the Barataria delta;

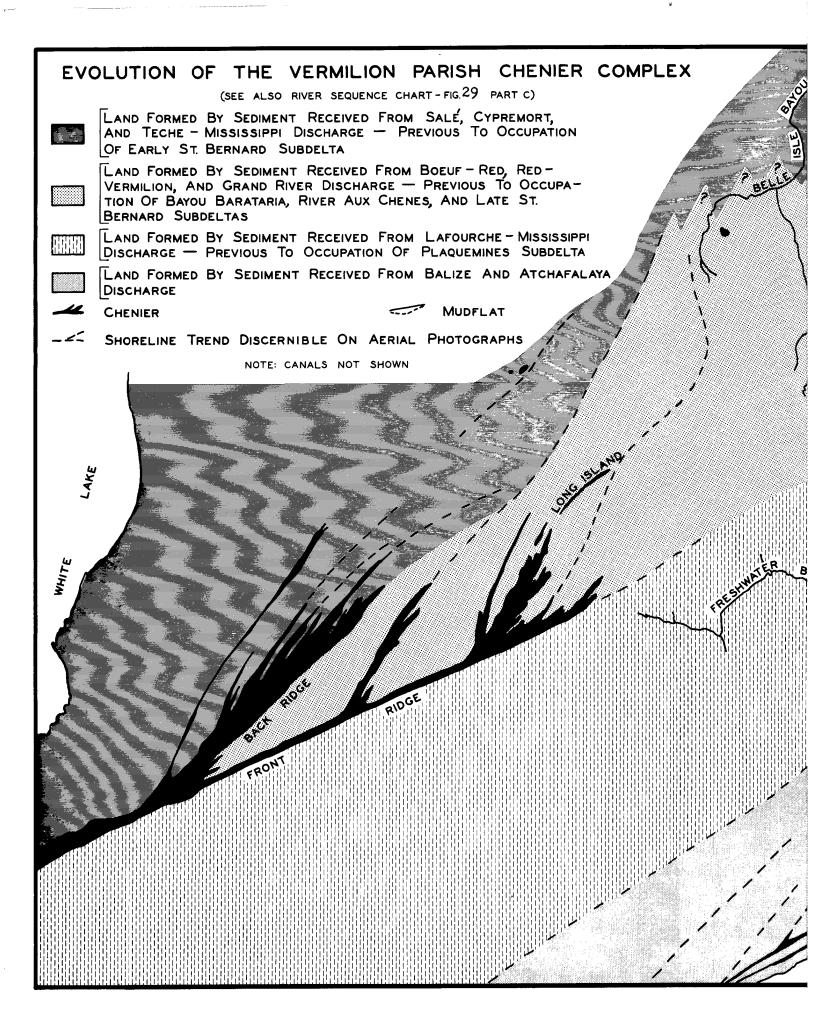
however, the following shift to the Bayou Chemier course probably cancelled this advance. Next the formation of the Balize subdelta advanced the shoreline of the parish Gulfward for a slight distance. Thus it appears that if Fisk's chronology is used the present shoreline of Vermilion Parish could not possibly be located more than a mile or two gulfward from Front Ridge. However, at the present time, the distance from Front Ridge to the Gulf is six to seven miles.

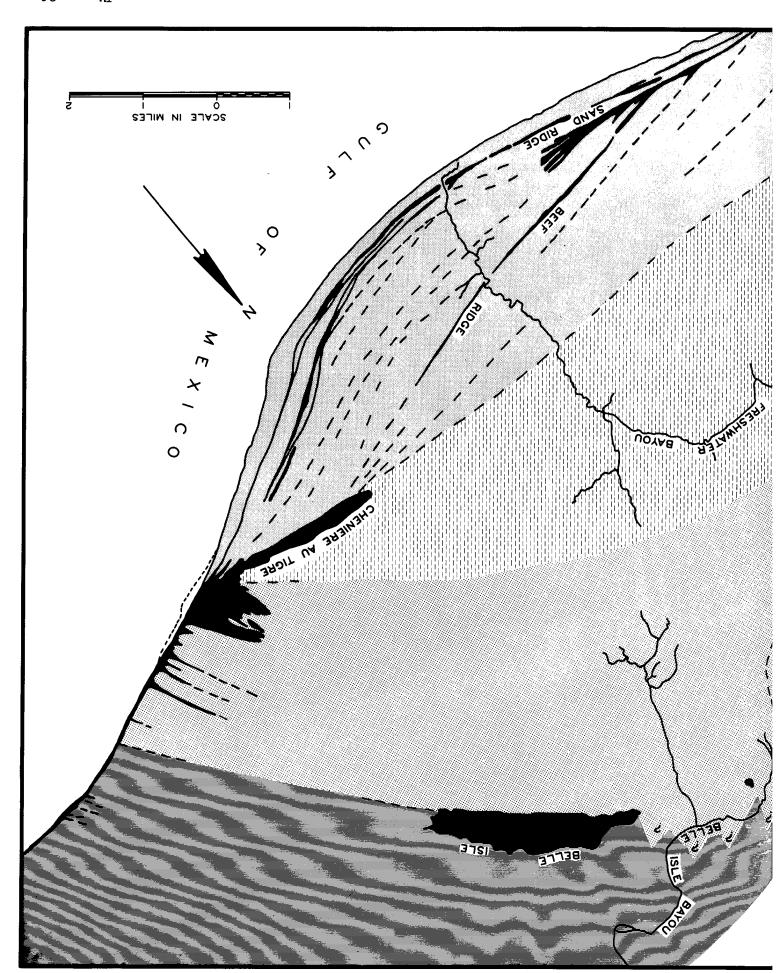
In addition, the pottery found in the Indian earth mounds located on Front Ridge indicates that the chenier was formed, and inhabited, by Coles Creek (850-1200 A. D.) time (McIntire, 1954). Using Fisk's chronology this situation is impossible as his postulated shift from the Lafourche course to the Metarie channel did not occur until approximately 1150 A. D. In other words, the shoreline retreat that gave rise to the formation of Front Ridge did not commence until the approximate end of Coles Creek time, a supposition that is refuted by the cultural evidence found in Vermilion

McIntire's suggested chronology more readily fits into the outline dictated by the chemier sequence. Therefore, the succession of courses suggested by the present writer (Fig. 29c) is but a slightly modified and augmented version of McIntire's, emphasis being placed on the courses and minor streams important to the chemier chronology of

Southwest Louisiana. Following this proposed sequence (Fig. 29c), the Front Hidge shoreline probably represents the retreat occasioned by the shift of the river to the Bayou Barataria-River aux Chenes delta and, subsequently, to the Late St. Bernard delta (Fig. 30). These shifts occurred during Troyville and early Coles Creek time. The following shift to the Lafourche Mississippi course, during late Coles Creek time, created the influx of sediment necessary to separate the Front Ridge shore line from the gulf by miles of marsh and fringing and flats. It should be noted that this sequence calls for initial occupation of Front Ridge during Coles Creek time, a demand borne out by the cultural evidence. Later, with the formation of the Plaquemines subdelta, retreat again occurred forming the K-W trending ridge of Chemier au Tigre. Initial Indian occupation of this ridge was during Plaquenines time (McIntire, 1954), which is in agreement with the described sequence of river shifts.

Aerial photographs of the Tigre Foint region reveal that it is composed of numerous narrow, sand-shell ridges separated by strips of marsh. The ridges usually overlie soft, slightly organic, blue gray clays of former mudflats. Although the dominant process operative in the Tigre Point region has been that of accretion, the ridges represent minor retreats and were probably formed during major



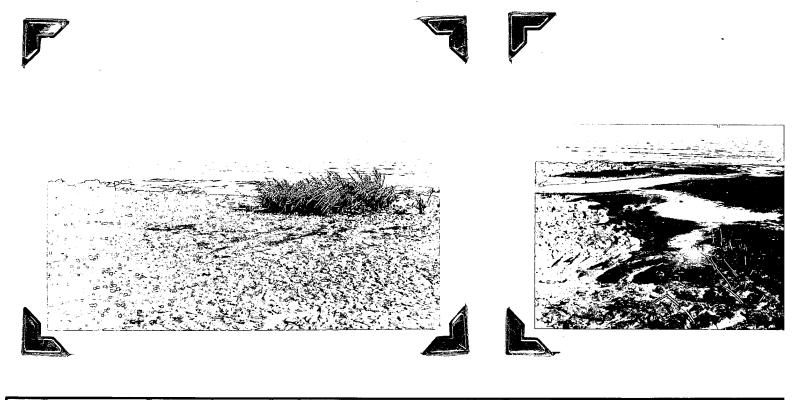


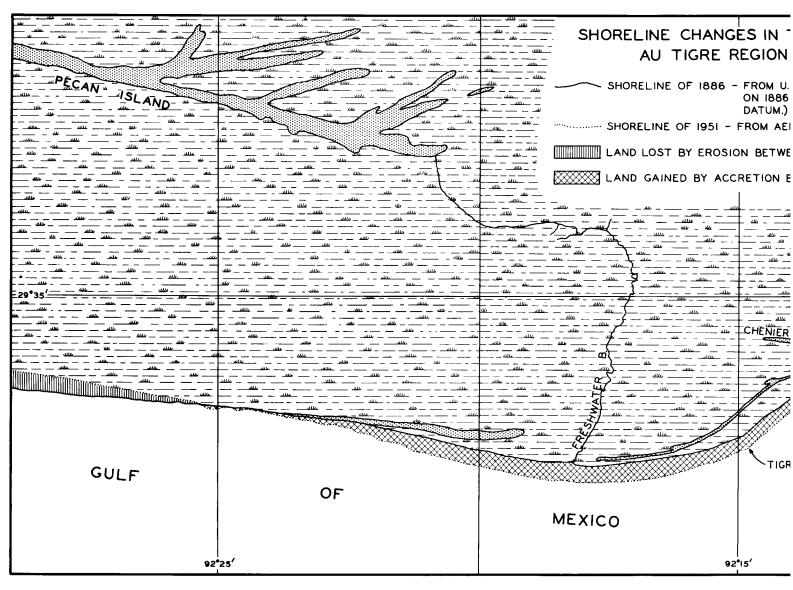
atorms. 28 The gulfward advance since Plaquemines time can, in part, be accounted for through erosion of the Chenier au Tigre ridges and the submerged shoal areas to the east. The detritus of these features is carried to the Tigre Point region by the westward directed longshore currents.

Another factor which has aided the accretionary processes in Vermillon Parish is the growth of the modern Balize subdelta. This delta has prograded farther southward than any previously existing eastern deltaic mass. Southwest Fass, which receives thirty percent of Mississippi River flow (Holle, 1952, p. 119), projects southwestward below the 29° N parallel of latitude. As the offshore currents in this portion of the Gulf set to the west (U. S. Coast Pilot, 1949, p. 46), clay-sized particles discharged at Southwest Pass may drift westward for hundreds of miles before settling a distance of twenty feet (Leipper, 1954; Bates, 1953. p. 2154; Scruton and Moore, 1953; Kuenen, 1950, pp. 253-254). A portion of the clay-sized material is, of course, flocculated and deposited near Southwest Pass; however, there can be little doubt that, owing to the position of the discharge area and the offshore currents, some of this material is transported westward for great distances.

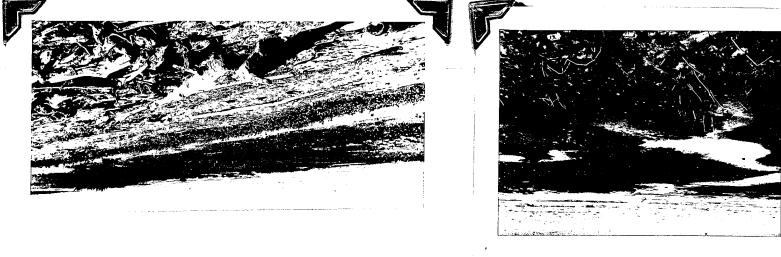
²⁸ Local inhabitants state that M. O. ridge, now located several hundred feet inland from the present shoreline, was formed, in its entirety, by the hurricane of August, 1915.

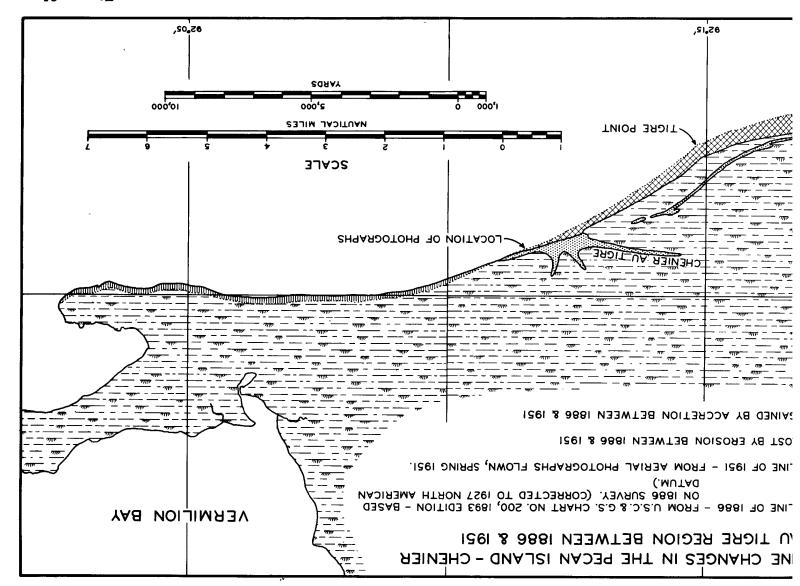
Figure 31 shows that although accretion is dominant in the Tigre Point area the shoreline is retreating to the east and west. The retreat is especially rapid farther west in Cameron Parish. As previously pointed out both the longshore and offshore currents transport material westward, however, the apparent concentrating of sediment in the Tigre Point area is rather difficult to explain. The writer believes that this concentration is dependent upon the bottom configuration of the gulf. Depth contours swing abruptly shoreward near Chenier au Tigre and thus outline the western limit of the extensive shoal areas which exist to the east (Fig. 2). Previous to the recent influx of sediment from the Atchafalaya Bay region the shoal areas and their flanking shorelines were devoid of a fine sediment cover. This condition suggests that the sediment-laden offshore currents from the Mississippi delta region probably parallel the gulfward border of the shoals. Currents rounding the southwestern extremity of the shoul areas possibly set up a clock-wise eddy in this region which would aid in sediment concentration. In addition, westward directed currents crossing the shoals would tend to deposit suspended sediment near obstructions to flow such as oyster reefs, and in the relatively deep, velocity diminishing, water of the Chenier au Tigre region. The continuing enlargement of the Atchafalaya River and the opening of the Wax Lake Cutoff has given











rise to the influx of sediment that has greatly accelerated coastal advance along the Marsh Island and Vermilion Parish shore. Coastal advance in the Tigre Point region since 1927 has been almost four times as rapid as during the preceding 89 years (Morgan, Van Lopik, and Nichols, 1953, p. 8).

wave refraction undoubtedly plays an important part in concentrating sediment in the Tigre Point region; however, detailed information for this area is not available. Nevertheless, it is obvious that the transporting power of southerly waves is dissipated near the Gulfward edge of the shoals, and the first locality, in this region, where waves from this direction could transport material to within a short distance of the shoreline is near Chemier au Tigre.

The preceding pages have dealt primarily with the post-Front Ridge shorelines. In the following discussion of the older chemiers, it is apparent that their correlation with shifts of the Mississippi deltas is not as certain as in the case of the younger ridges. However, any analysis of the pre-Front Ridge chemiers should take into account the following facts:

- (1) The older shoreline ridges are usually composed primarily of oyster shell.
- (2) Tchefuncte pottery is found on the ridges projecting northeastward from Back Ridge.
 - (3) Belle Isle, an abnormally large beach deposit,

is composed primarily of silt and sand; not decomposed shell such as usually constitutes the nearby ridges.

The writer believes the tentative early shoreline history outlined below is in keeping with the known facts.

The gulfward concavity exhibited by the early shorelines of Vermilion Parish is probably due to the presence of the Bayou Cypremort-Sale' deltas to the south and southeast and the relative "high" of the Fleistocene meander belt to the west (Plate I, Fig. b and Fig. 16). This region, therefore, possibly originated as a shallow delta flank depression flanked by numerous oyster reefs. Subsequent influx of sediment during the occupation of the Teche-Mississippi course led to a spasmodic shoreline advance, marked by minor retreats. The fluctuations in this advance were probably due to the changes in water volume and sediment load of the Teche-Vermilion, which during this time probably discharged near the present site of Belle Isle. (The early history of the Vermilion River, outlined in the Teche-Mississippi section -- Fig. 25, certainly seems to indicate that great changes in the water volume and sediment load of the stream did occur.) Concentration of sediment at this point also helps to explain the silt-sand composition of Belle Isle.

With the shift of the Mississippi to the Early St.

Bernard delta, shoreline retreat prevailed in Vermilion Farish, possibly giving rise to the formation of Back Ridge.

This would allow the apparently truncated ridges projecting northeastward from the island to be occupied by Indians during early Tchefuncte time. A portion of the sediment which produced the coastal advance from Back Ridge to south of the present location of Front Ridge was probably brought into the area by the Red-Vermilion (flowing in the Teche-Vermilion channel). Additional sediment was supplied to the westward moving longshore current by Grand River-Belle River outlets and the destruction of pre-existing deltas located to the east of Vermilion Parish. The following river shifts to the Bayou Barateria-River aux Chenes and Late St. Bernard deltas led to shoreline retreat and the formation of Front Ridge. These latter, and subsequent, shifts have already been discussed and correlated, with a greater degree of certainty, with the chenier sequence found in Vermilion Parish.

The information presented in this section is summarized in Part C of Figure 29 and Figure 30.

MODERN CONDITIONS AND THENDS IN CENTRAL COASTAL LOUISIANA

Deposition is the dominant process operative today in central coastal Louisiana. Even though shoreline retreat is active along some of the bay shores, these water bodies are slowly being filled with sediment brought into the area, for the most part, from the east. The coastal advance presently occurring along the gulf shore of Vermilion Parish and the filling of the Atchefalaya Basin have been briefly mentioned previously. The recent reports of Fisk (1952) and Morgan, Van Lopik, and Nichols (1953) deal primarily with the sedimentation occurring in these two areas. The writer feels that the conclusions put forth in the above mentioned publications present an adequate, concise picture of the present conditions and trends in central coastal Louisiana. These conclusions are reproduced below.

Fisk (1952, pp. 140-142):

The Atchafalaya distributary is following a developmental pattern characteristic of former Mississippi River diversions each of which within an estimated 100-year period captured the entire flow of the master stream. Now that a channel capable of carrying low-water flow has been established and enlargement has begun, no natural processes are known which in the case of the Atchafalaya might prevent further enlargement and eventual diversion of the entire Mississippi flow.

The Atchafalaya at the present time is in its intermediate stage of diversion. Engineering studies show that approximately twenty-five per cent of the water of the Mississippi is being diverted. The present study

has shown that a critical stage is to be expected at some time before fifty percent of the flow is diverted. Following this critical stage, closure of the Mississippi River below Old River will be rapid and diversion will be relatively uncontrollable. A conservative maximum estimate as to when the critical stage will occur is based on the time of forty percent diversion. Trends established by present measurable rates of Atchafalaya development are as follows:

a. The trend established by the percentage of total annual flow diverted from the Mississippi through Old River shows that forty percent of the Missis-

sippi flow will be diverted by 1971.

b. Trends based on the time when the channel of Old River and the upper Atchafalaya River will have sufficient cross-sectional area to accept forty percent of the flow of the Mississippi, bracket the time between 1965-75.

c. Trends based on the rate of filling of Grand Lake and the establishment of a channel from the head of the Atchafalaya distributary to its mouth in Atchafalaya Bay, show that this condition can be

expected between 1970-75.

d. Trends based on the rate of bank migration and channel enlargement at the point of diversion indicate that a critical stage of diversion will be reached in 1970.

It is concluded, therefore, that under normal conditions of development the diversion will have reached a

critical stage between the years 1965-75.

Factors which will accelerate the diversionary process are the frequency of floods or sustained high-water flows through the distributary, continued dredging in the lower Atchafalaya Basin, and a critical stage of development occurring before the time of forty percent diversion. In connection with this last factor, any sudden increase in deterioration of the Mississippi channel immediately below the point of diversion should be interpreted as marking the beginning of the critical stage.

Morgan, Van Lopik, and Nichols (1953, p. 34):

Deposition of fine clay or "mud" has occurred along the western Louisiana coast for a distance of about fifty miles during the last five years. The fine clay in places has formed rather broad mudflats seaward from silt and shell beaches. The mudflats are underlain by soft clay and silt deposits which vary to a maximum of

some six feet. In some places the mudflats consist of very uniform, fine-grained clay, while in others there are thin silt partings in the mud deposits. The soft, ozy mud in some places overlies eroded, firm, marsh clays and in other places silty beach materials.

localized mud concentration, in the form of flats, is normally a slow process but is often accelerated by southerly storm winds. If the mudflats are not removed by subsequent storms, vegetation soon alters the barren flats into coastal marsh. One growing season will often convert large areas to oyster grass marsh. The fine-grained mud seems to be extending itself gradually in a westerly direction and at present is virtually continuous as far west as the mouth of Rollover Bayou. A few isolated patches of mud flank the beach even farther to the west.

The material forming the mudflats is Mississippi River sediment which is being carried to the Gulf by the Atchafalaya River distributary of the Mississippi River system. The Atchafalaya has increased its proportion of total Mississippi River flow appreciably during the last five to ten years. The Atchafalaya River discharges its waters and sediment into large shallow lakes (Grand Lake and Six-Mile Lake) which serve as settling basins, at least for the coarser particles. Fine-grained muds remain in suspension and are carried into Atchafalaya Bay by the Lower Atchafalaya River and the artificially constructed Wax Lake outlet. Most of the mud remains in suspension until carried beyond the limits of the essentially fresh-water bay. Unce beyond the limits of the bay the fine muds are carried westward along the coast by prevailing longshore currents. This process is resulting in the stranding of old silt and shell beaches behind a zone of newly-developing mudflat marsh.

Atchafalaya channel, obviously great changes would occur in the coastal area of central Louisiana. Events such as the complete filling of Grand and Six-Mile Lakes, great enlargement in the width of the Atchafalaya River, the building of an ever-expanding delta in the present Atchafalaya Bay region, and rapid coastal advance in the western parishes would certainly take place. Revolutionary as these changes

seem, similar modifications have taken place many times in the Recent history of coastal Louisiana and merely represent an acceleration or shift of processes now operative.

POSSIBLE EFFECTS OF MODERN SEA LEVEL RISE ON COASTAL LOUISIANA

In the light of data presented by Marmer (1948, 1952), there seems to be justification in assuming that a rise of sea level, at least along the coasts of the United States, is taking place at the present time. In his discussion of the Gulf Coast area Marmer (1952, p. 67) states:

For Galveston the results are especially interesting since a continuous series of forty years is available. During this time sea level has changed by almost exactly one foot, but the results clearly indicate a change in rate of rise between 1937 and 1938. From 1909 to 1937 the rise was at a rate of about 0.015 foot per year, while since that year the rise is at the rate of about 0.05 foot per year or more than three times the previous rate.

A rapid acceleration of rise since the 1930's is also noted along the Atlantic and, to a lesser degree, Facific coasts. It is extremely doubtful that this acceleration has been caused by a recent pronounced increase in regional subsidence, therefore, the movement must be accepted, in part, as a definite indication of a recent rise in sea level.

Numerous glacial geologists have also presented information indicating recent shrinkage of glacial volume, due to a general warming of the climate, thus, dictating a rise in sea level. Matthes (1945, p. 231) states:

... not only has glacier shrinkage been general in both Hemispheres during the last ninety years, but even some of the lesser variations during that period have synchronized rather closely. Most remarkable is the synchronism of the latest phase—the sharply accelerated recession during the later 1930's. THORAK-INSSON characterised it as "catastrophic;" SPEIGHT termed it "abnormal" (personal communication dated December 31, 1940), and BROGGI calls it "unusual" (accleracion inusitada).

In his excellent and comprehensive paper, Thorarinsson (1940, p. 151) opines that "The ice-thinning in the last
few decades of the world's glacier districts, exclusive of
the whole Antarctis and the accumulation area of Greenland
ice, has thus-ceteris paribus--resulted in the ocean level's
being raised eustatically about 0.05 cm (0.02 in.) per
annum." Thorarinsson believes the figure of 0.05 cm per
annum to be the minimum rise necessitated by glacier melting.

1

Meteorologists are cognizant of this trend to a warmer climate. For example, Willet (1949, p. 43) makes note of ". . . the marked secular trend of the last sixty years (1880-1940) in all parts of the world toward the shrinkage of glaciers, drying up of lakes, and the increase of temperature in the higher latitudes."

The economist William J. Baxter (1953) in his book

Today's Revolution in Weather cites numerous reports of sea
level rise and climatic amelioration from all over the

world.

Before discussing the possible effects of a hy; othetical sea level rise of approximately fifteen feet on coastal Louisiana the writer would like to emphasize several facts. Firstly, although there can be little doubt that a custatic rise in sea level is in progress today the amount of ascent in different parts of the world, due to local and regional conditions, will certainly vary in magnitude. For example, coastal areas experiencing tectonic uplift or glacio-isostatic adjustment may easily exhibit, depending on the amount of upheaval, no evidence of sea level rise or possibly a downward movement. 29 Therefore, the actual amount of sea level rise can be accurately measured only along the coast of an absolutely stable area, and as the majority of structural geologists either cannot agree on the location of such a region or doubt the existance of same, the writer believes that the best estimates of the custatic change, inaccurate as they may be, are those made by the glacial geologists based on volumes of glacier loss.

Secondly, there is no definite proof that the present conditions represent a minor secular fluctuation, the beginning of a major climatic trend, or a minor fluctuation superimposed on a major trend. The rapidity of change since the 1930's, however, seems to favor the minor fluctuation hypothesis.

²⁹ Marmer (1952, p. 66) indicates that sea level has been falling along the coast of Alaska since 1940. Valentin's (1952, Tafel 2) recent map, showing the relative movement of the world's coasts, indicates the great variations of apparent sea level movement that can result from local and regional conditions.

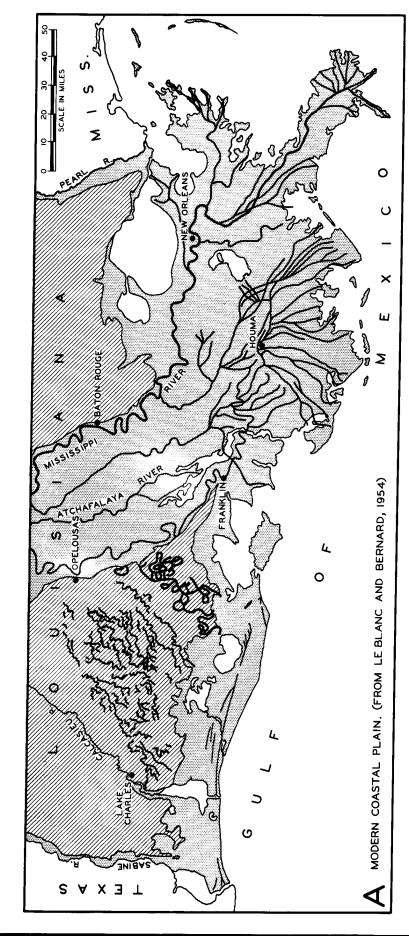
Thirdly, it should be borne in mind that the following discussion of the effects of sea level rise applies prinarily to coastal Louisiana and, due to the many conflicting
processes operative in apparently similar areas, should not
necessarily be considered typical of all delta regions.

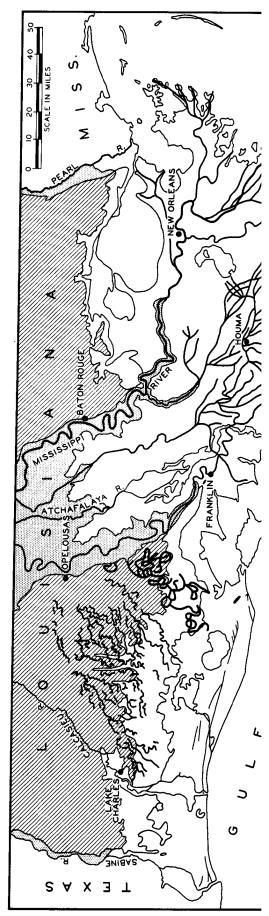
The low coastal areas of Louisiana extend inland for distances of from twenty-five to minety miles before elevations of fifteen feet above sea level are reached (exclusive of isolated beach ridges or levees). The normal tidal fluctuation along this coast is less than two feet. Hurricanes have raised water levels in certain areas by approximately ten feet. In view of the above facts a slow sustatic sea level rise of ten or fifteen feet would apparently have dire results. LeBlanc and Bernard (1954) have depicted the apparent effects of a fifteen foot rise in sea level on coastal Louisiana. (Fig. 32a and b). However, other concurrently operative processes would undoubtedly make the effects of such a rise decidedly less pronounced. Consider, for example, the effect of a slow sea level rise on the Mississippi River, which controls coastal development in Louisiana. During this rise a lesser volume of flood water would overtop the banks, thus making flood control more difficult. However, leves formation should keep pace with the sea level ascent, and flood stage should remain fairly constant. Another effect of this overtopping would be an increased tendency

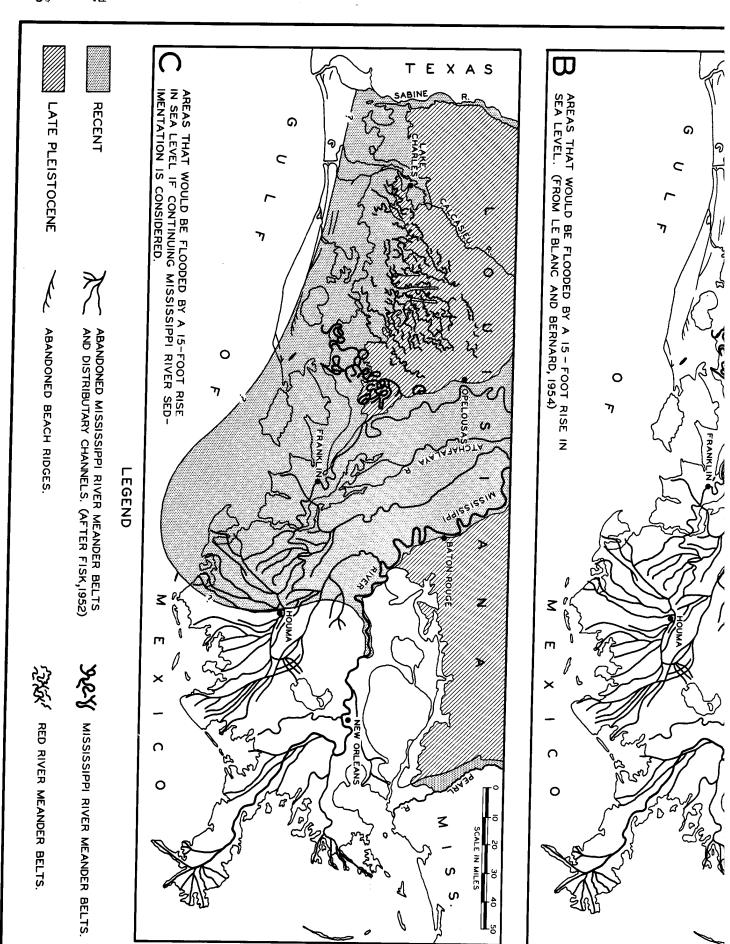
for crevasse channel formation and the adoption of a shorter course to the gulf, either by (1) extension of a crevasse channel, (2) occupation, through crevassing or lateral junction, of a closely parallel flowing stream course, or more probably, (3) occupation of a suitable existing distributary, such as the Atchafalaya.

This diversion would thus bring about the transference of the gulf discharge area of the Lississippi River from its present location in water that rapidly reaches a depth of sixty feet to the shallow Atchafalaya Bay region. delta formed in this shallow embayment would require a progradation of over forty miles before a water depth of sixty feet is reached. Therefore, it is apparent that the delta formed here would differ radically in its appearance from the present birds-foot delta of the Mississippi. With the same volume of sediment being deposited in the Atchafalaya Bay area as is presently discharged at the Hississippi mouths, the new delta would assume a more typical fan-shaped outline characteristic of most pre-Balize Mississippi deltas. Lateral and gulfward expansion would take place at a phenomenal rate, and growth would occur in spite of a rising sea In other words, the shoreline of the central one third of Louisiana would definitely maintain itself and, in all probability, advance even in the face of a relatively rapid sea level rise (Fig. 32c). The shoreline of the western one

POSTULATED EFFECTS OF A FIFTEEN-FOOT RISE IN SEA LEVEL ON COASTAL LOUISIANA







third of the state would retreat slightly, or possibly maintain itself due to the influx of sediment carried by the westward trending currents. The shoreline of the eastern one third of Louisiana, however, due to the combined effects of subsidence, sea level rise, and the lack of a nearby sediment supply would undoubtedly retreat. The coastal outline of this eastern area would consist of two embayments (one in the Lake Borgne-Mississippi Sound region; the other, in the Barataria Bay-Lake Salvador-Timbalier Bay area, flanking the eastern side of the Atchafalaya delta) partially separated by a short prong of land composed of the remnants of the present Mississippi levees which extend southeastward from New Orleans. Thus it is easily possible, using present day data and trends, to visualize a situation in which a fifteen foot rise of sea level would result in but slight areal loss to the coast of Louisiana.

Barton (1928) has previously suggested that a ten foot rise in sea level, or submergence, would have little effect on the lower courses of streams "that are flowing with their water level at, and the bottom of their channel a considerable distance below, the water level of a lake, bay, gulf, or ocean into which they are flowing." Barton deals mainly with the effect of sea level rise on the mean-dering tendencies in the lower portion of rivers such as the Brazos, and although meandering in the distal portion of

the Mississippi has been curtailed due to the composition of its bed, the present writer believes that the tendency to meander is inherent, thus making some of Barton's remarks applicable to the Mississippi River. Barton (1928, p. 620) states:

A submergence of ten feet, which is greater than the probable submergence in the lower courses of the San Jacinto River, presumably would not cause any very great change in the behavior of the Brazos River in the lower 48 1/2 miles of its course. . .

If a slow subsidence were occurring, progressively lesser floods would send the stream out of its banks; and the building up of levees would be increased concomitantly and would probably keep pace with the subsi-The mean gradient both of the water level and the bottom of the channel would be slightly decreased for the whole stretch below Bolivar Falls. If the bottom of the channel were not built up to keep page with the levees, the effective volume of the channel would be oversize in ratio to the volume of stream flow and would tend to reduce the stream velocity, which in turn would favor deposition and filling of the channel until the ratio of channel capacity to the volume of the stream flow were brought back to its present value. The natural levees and the bottom of the channel of the meander near Freeport would be built up simultaneously, and the same conditions of stream flow would then prevail as at present, and the meander should continue to move seaward, unless, or until, obliterated by the retrogression of the shore line consequent upon the subsidence. lower course of the stream from above Richmond to the gulf ultimately should become adjusted to a cross-section like that at present and to a longitudinal profile with a very slightly lower mean gradient than the present one. Yet it seems doubtful that the gradient would be less at any point than the present gradient in the stretch where the Freeport meander is actively moving. The conclusion therefore follows that the present tendency to meandering would continue in the lower reaches of the Brazos even in face of a progressive slow subsidence.

If the subsidence were sudden, shoreline erosion and alongshore currents might obliterate the lowest few miles of the stream, but in general the present channel, aided by the natural levees, would tend to hold the

ourrent to its present course just as now happens in time of high flood; the leves would tend to be built up to the new gulf level, and at times of flood, above it; and the river would tend ultimately to adjust itself to the same profile as if the subsidence had been slow and progressive. . .

Therefore, the supposition that a ten or fifteen foot sea level rise would not bring about any gread areal loss to the Louisiana coastal regions or produce any great changes (aside from possible diversions) in the Gulfward flowing streams seems justified. Consequently, if such a sea level rise has taken place during Recent time its occurrence would be difficult to ascertain on the basis of evidence that might possibly be found in the deltaic portions of Louisiana. This evidence, also, could easily be designated as effects of subsidence or deltaic shifts, thus making interpretation doubly difficult.

SUMMARY

On the preceding pages an attempt has been made to outline the late Quaternary history of south central Louisiana. Arbitrarily beginning the historical examination with the Early Wisconsin glacial stage, the origin of the sediments now exposed in the area and the modifications giving rise to the present topography have been discussed. The thousands of feet of pre-existing sediments that underlies this region have, thus, been more or less ignored. It should be borne in mind, however, that many of the tectonic trends of these older strate are reflected in the overlying quaternary deposits.

ment and expansion of the polar ice sheets resulted in a lowering of sea level. This drop in sea level forced the Gulf Coast streams to entrench and thus cut deep valleys into the pre-existing Tertiary and Early Pleistocene sediments, which were in the process of being downwarped toward the gulf and uplifted inland. During this time large quantities of coarse sands and gravel were carried to the gulf. With the climatic amelioration and glacial waning, which characterized the Peorian Interglacial stage, sea leve rose. As the waters advanced headward along the entrenched valleys

a sub-sea wave of coarse alluvium extended up-valley along the valley floor. Finally a time of equilibrium was reached when, due primarily to the slowing down of sea level rise, alluviation began to keep pace with the transgressing waters. The shoreline no longer retreated. Subsequent to this time the major streams began to build deltas gulfward and blanketed the previously deposited coarse material in the troughs with a layer of finer alluvium. Some of the stream course and delta shifts of the Mississippi and Red Rivers, during this time, have been outlined by Fisk (1948). As a result of this deltaic expansion the shoreline edvanced, in some areas, to positions far gulfward of its present location. The sediments, deposited during the Peorian inter-glacial stage, forming what is now known as the Prairie formation, has been subsequently downwarped toward the Gulf and uplifted inland.

with the lowering of sea level during the Late Wisconsin glaciation entrenchment of streams into the newly formed Prairie surface took place. Again great quantities of coarse sand and gravel were transported beyond the shoreline, which, due to the lowered sea level, was located far beyond the present shore. Subsequent climatic amelioration and glacier waning brought about another rise in sea level, the start of which marks the beginning of the Recent epoch. This event probably occurred between 25,000 and 15,000 years

ago. Accompanying this rise of sea level was the inevitable wave of coarse alluvium extending up-valley in the wake of the inland projecting fingers of water that occupied the valleys previously cut in the Frairie surface.

Approximately 5,000 years ago a point was reached where the deposition could keep pace with the slowed down rise in sea level, and the shoreline no longer retreated. Whether the sea level reached this -5,000 year position after a steady, gradual rise, a rise marked by several minor fluctuations, or if this position was higher than modern sea level are questions still open to debate. Nevertheless, the available evidence seems to indicate that approximately 5,000 years ago deltaic growth began to displace the water that had extended up the Mississippi Alluvial Valley, possibly to the latitude of Baton Houge. This gulfward growth was accompanied by many shifts both in course and location of the active delta. Thus, a front of fine alluvium was pushed gulfward over the previously deposited sediments in the troughs (consisting of coarse basal fluviatile deposits, overlain by estuarine and marine sediments) and the inter-trough older deposits.

The first readily discernible course and delta in central coastal Louisiana is that of the Bayou Sale' system. This stream probably came into existence about 600

B. C.³⁰ Various portions of the Sale' system served as a major distributary or the main channel of the Mississippi River from 500 to 300 B. C. Subsequent diversion of flow, forming Bayou Cypremort and possibly other distributaries extending eastward into the present lake Verret-Thibodaux region, brought about the gradual abandonment of the southern portions of the Sale' system. Still later, about 100 B. C., the Teche course of the Mississippi River was established. The Vermilion River originated as a distributary of the Teche-Mississippi. The Teche-Mississippi utilized Bayous Cypremort and Sale' as distributary channels.

Subsequently when the Teche-Mississippi course was abandoned in favor of the more eastern Early St. Bernard sub-delta courses the Red River occupied the abandoned channels and utilized the Vermilion River as a distributary. Bayous Cypremort and Sale' did not function as important distributaries of the Red, but probably received flood flow.

During the Sale', Cypremort, and Teche-Mississippi stages the shoreline in the eastern portion of the region

³⁰ The dates presented here are speculative. They are based primarily upon the cultural chronology of Phillips, Ford, and Griffen (1951), the river sequence dating of Fisk (1944), and the writer's personal opinion. The age sequence of the streams, however, is valid. The methods used in establishing the relative ages have been fully discussed in the report and it should be pointed out that the sequence was definitely not formulated on the basis of cultural evidence alone.

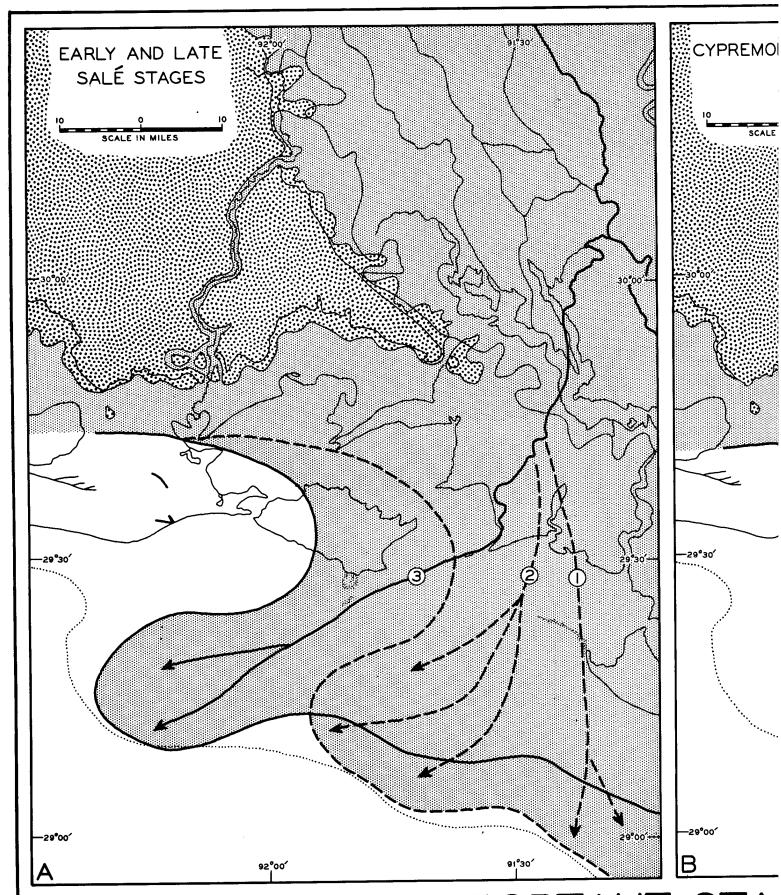
was located gulfward of its present position. This was not the situation in Vermilion Farish, however, where a relatively large embayment existed, the borders of which are now outlined by oyster shell ridges. The filling in of a portion of this embayment, subsequent to Teche-Mississippi time, makes it possible to judge, in part, the validity of proposed deltaic sequences. A slightly modified version of the sequence proposed by McIntire (1954) most closely fits the pattern dictated by this chemier complex of Vermilion Parish.

are retreating; however, the water bodies themselves are concomitantly filling in. The gulf shoreline of Marsh Island is retreating, but not at the rate indicated by a comparison of older charts. In other words this retreat has slowed down and probably will reverse in the near future. This change from shoreline retreat to shoreline advance, has already occurred along most of the gulf shoreline of Vermilion Parish. In the Chenier au Tigre region, for example, wide mudflats, the inner portions of which have been converted to marsh, have built gulfward within the last ten years. The progressive enlargement of the Atchafalaya River, at the expense of the Mississippi, has brought about this recent influx of sediment. This trend will undoubtedly be maintained and could be greatly accelerated if the present

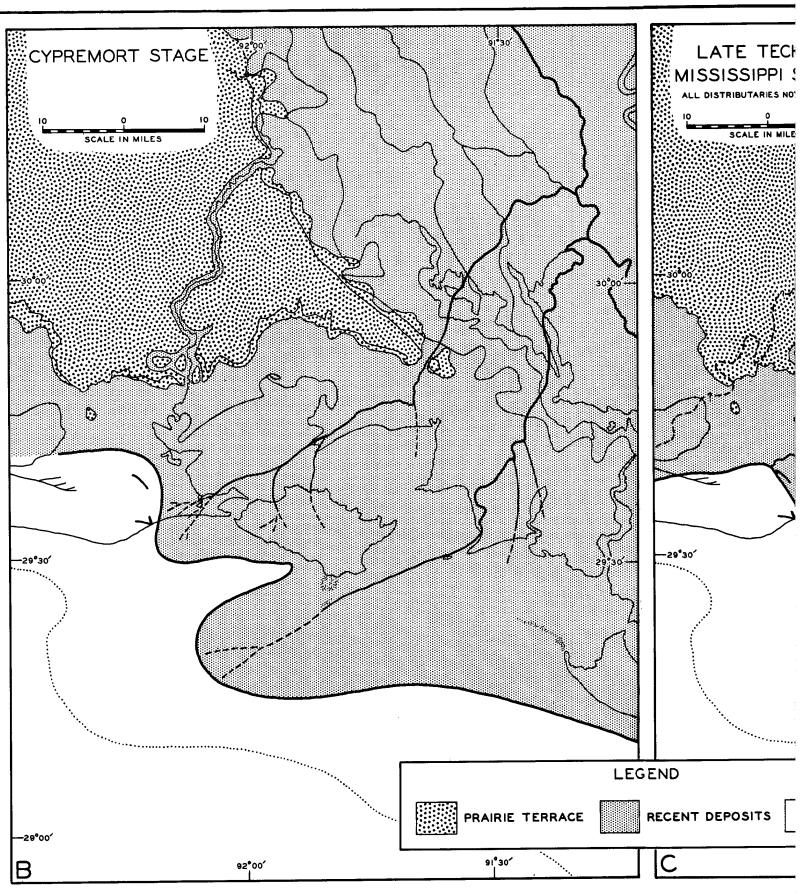
rise of sea level noted by Marmer (1949 and 1952) continues.

Man's intervention will be necessary in order to prevent the Atchafalaya from diverting the Mississippi and forming a huge, gulfward expanding delta in the Atchafalaya Bay region.

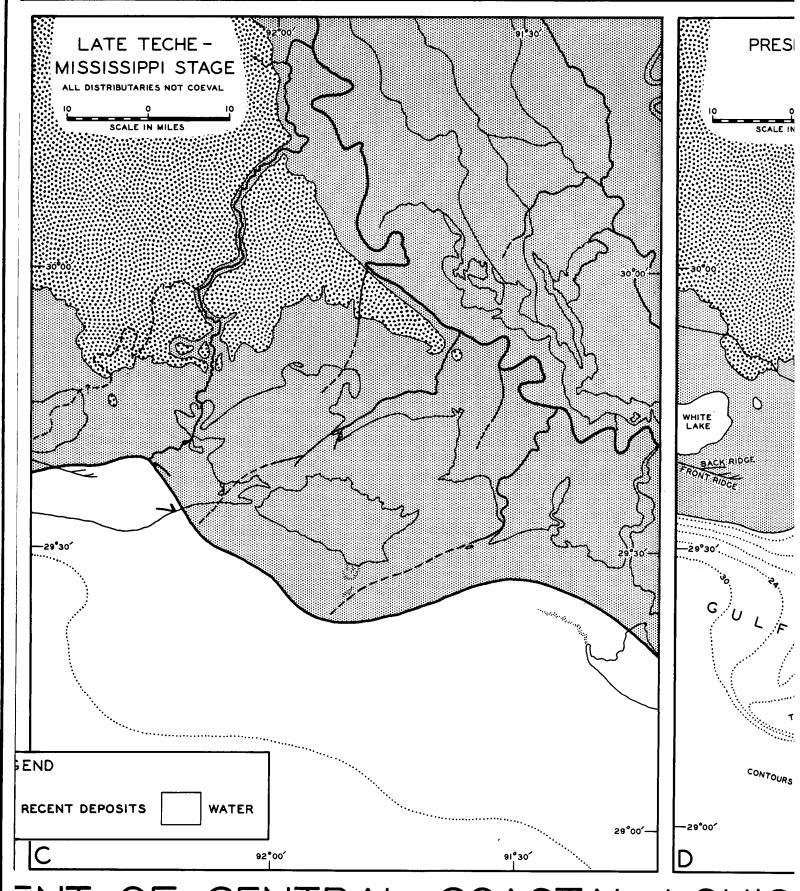
The preceding surmary briefly states some of the conclusions arrived at in this work. These conclusions, and others previously mentioned, are based on data that were collected by the writer over a four year period. The writer feels that the conclusions reached fit the available data most logically, although, admittedly, in a few cases, different hypotheses could be proposed. Additional factual information should, by all means, be sought in an attempt to either strengthen or disprove many of the hypotheses. Thus, as is so often the case in geologic pursuits, the end of a report is in reality the beginning of the work to be done.



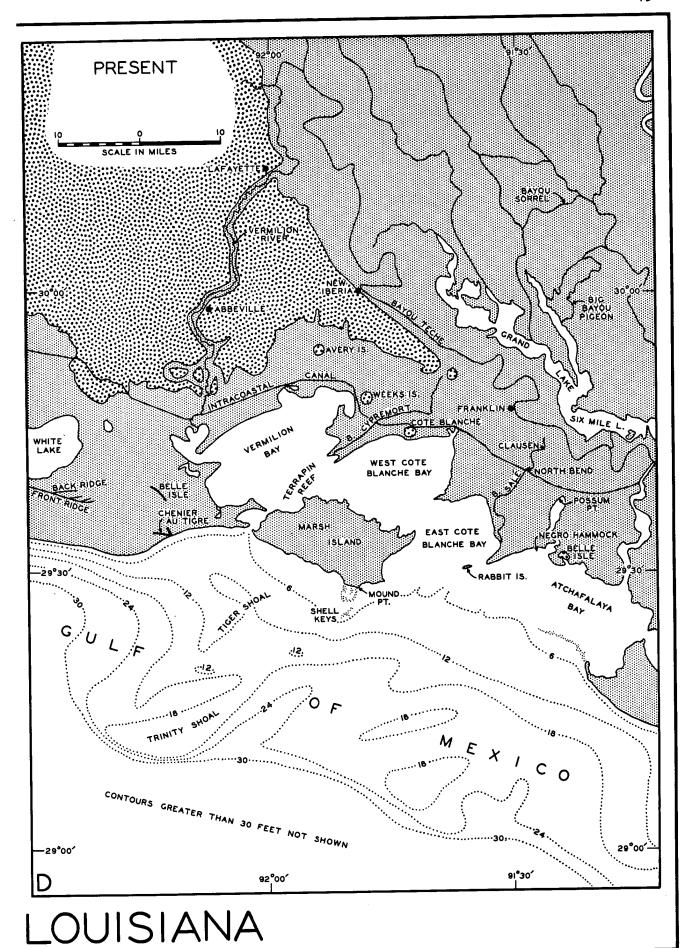
IMPORTANT STA



STAGES IN THE DEVELOPMENT OF



ENT OF CENTRAL COASTAL LOUIS



The following section was deleted from the final copy of the thesis at the suggestion of the Louisiana State University Geology Faculty.

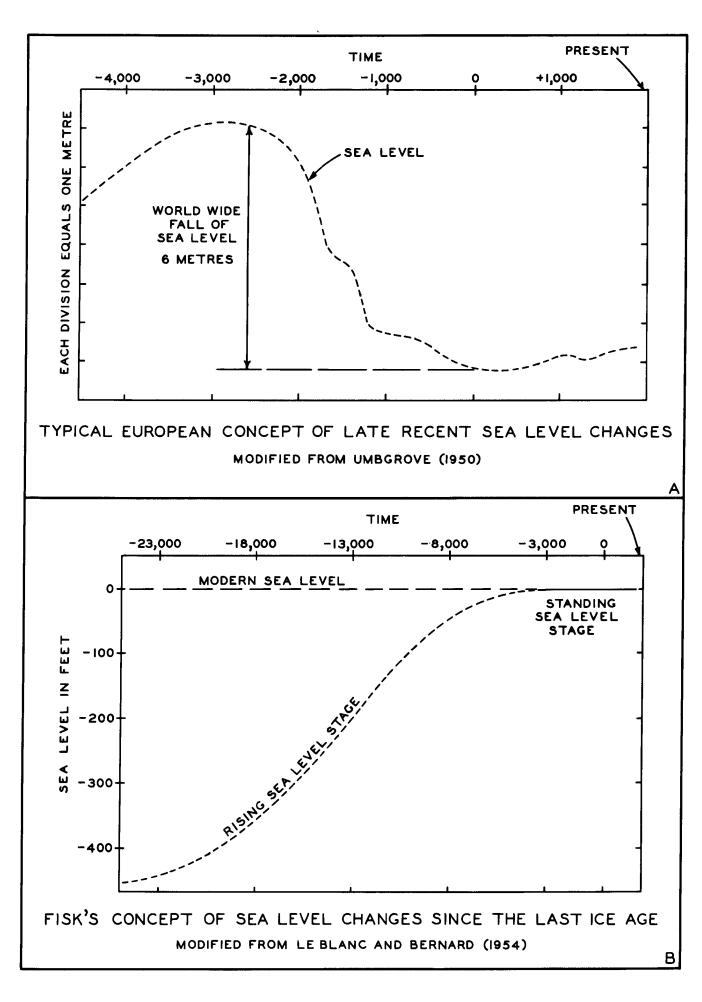
SEA LEVEL FLUCTUATIONS AND THEIR LFFECTS ON COASTAL LOUISIANA

The Climate Optimus

Most European workers are convinced of a eustatic rise and fall of sea level, during the Recent epoch. In general, they believe that following the recession of the last ice sheet, there was a period of some 4,000 years, from about 5,000 to 1,000 B. C., when the world climate was signigicantly warmer, and the sea level stood some fifteen to twenty feet higher, than at present (Fig. Xa). The peak of this period of warmth and high standing sea level is known as the Climatic Optimum. North American geologists have been hesitant in accepting the existence of a climatic opti-Fisk (1944, 1947, 1952), for example, believes that sea level began to rise with the melting of the Pleistocene glaciers, approximately 25,000 years ago and continued until about 5000 years ago when sea level reached its present level. According to Fisk there have been no changes in sea level during the last 5,000 years (Fig. X b).

Nevertheless, several American workers have found evidence of the occurrence of the Climatic Optimum. Matthes (1940, p. 398) concludes that:

The present cirque-glaciers on the Sierra Nevada of California represent a new generation of ice-bodies of late Fost-Pleistocene origin, at most 4,000 years old, and not dwindling remnants of the great ice-streams of the Pleistocene epoch. They occupy the cirques that were left empty by the complete extinction of their Pleistocene predecessors during the warm and dry middle portion



of the Fost-Pleistocene interval.

The majority, perhaps all, of the cirque-glaciers and tiny glacierets that exist today on the other mountain ranges in the western United States by inference belong to the same new generation. . .

Flint and Deevey (1951, p. 275) point out that:

An episode of dry climate has been discerned in pollen diagrams from the Iowa prairie (Lane, 1931) as well as in the more arid Basin and Range Province (Hansen, 1947). The age of some lakes in the Province, as calculated from their salinity, is around 4,000 years. As these lakes are descendants of Pleistocene lakes, their youth has been accounted for by the widely accepted hypothesis that they went dry at the time of the thermal maximum (Climatic Optinum).

Furthermore, Leopold and Miller (1954) recognize the effects of the Climatic Optimum on the soils and terraces of some alluvial valleys in Wyoming.

In the Gulf Coast region, MacNeil (1950) tentatively considers the five foot Silver Bluff terrace of Florida and Georgia to be the remnant of the Climatic Optimum shoreline. This shoreline can be traced westward to Mississippi on the available USGS quadrangles. In Mississippi Robert Treadwell has found what may possibly be indications of a former higher stand of sea level evidenced by beaches that overlap Pleistocene deposits in the area (personal communication). William McIntire, on the basis of two preliminary surveys, along the northern shore of Lake Pontchartrain and the eastern coast of Texas, is of the opinion that possible evidence of a higher sea level stand, in the form of stranded oyster reefs, exists in these areas (personal communication). Although the above work is certainly incomplete and inconclusive as yet, it

indicates that, with further investigation, evidence of the Climatic Optimum in the central Gulf Coast region may be discovered. Therefore the conclusion reached by LeBlanc and Bernard (1954), that there is no evidence in the Gulf Coastal area to indicate any relative change in sea level during the last 5,000 years, seems rather premature. The writer is in agreement with LeBlanc and Bernard on the point that, if a Recent rise and fall of sea level has occurred, late Recent marine sediments, faunas, and/or shoreline features should occur above or within the modern coastal plain of Texas. However, he believes that these indicators could very possibly be absent from most of Louisiana. This belief stems from the supposition that the volume of sediment carried to the Gulf by the Mississippi River would be sufficient, even in the face of a slow ten to fifteen foot rise in sea level concommitant with subsidence, to maintain a growing delta and, due to sediment transport by longshore currents, a relatively stable shoreline along approximately two-thirds of the Louisiana coast. Apparently LeBlanc and Bernard fail to consider the important factor of continuing deposition during a rise in sea level. (See Fig. 32, parts A and B, of which are reproduced from their paper).

At the time the Climatic Optimum allegedly occurred the active delta of the Mississippi River was undoubtably located in the central portion of coastal Louisiana. Thus the sea would have transgressed only across the eastern

portion of the state, forming an embayment of considerable extent with beaches on the southern slope of the Prairie terrace in the latitude of the present northern shore of Lake Pontchartrain. As sea level dropped to slightly below its present level, these beaches would be stranded and at the present time should be found above the modern coastal plain at an elevation of several feet. The shoreline features should also be depressed to the westward (toward the axis of the Mississippi Alluvial Valley) as a result of local subsidence due to loading of the active and pre-existing deltas. Another factor to be borne in mind is the increased importance of compaction during a fall in sea level. As the water content of previously deposited sediments is reduced volume loss will result, thus lowering of shoreline features and sediment types will take place. Thus it is possible that, with a reappraisal of the effects of sea level rise and further field work, much additional evidence for the Climatic Optimum in the Gulf Coast will be brought to light.

In summary, stranded shorelines should exist in some portions of Louisiana, the regions dependent upon the location of the active delta during the Climatic Optimum, along most of the Texas coast, and certainly in Mississippi and eastward. The present writer is not familiar with the situation in Texas, however, there is certainly a possibility that such shorelines do exist in eastern Louisiana, Mississippi, Alabama, and Florida. These features should not

necessarily be found at the surface in the remainder of Touisiana; however, some evidence of a former high stand of sea level should exist in the western part of the state. In addition, it seems improbable that the sea level rise possibly reflected in the Gulf Coast was of the magnitude (approximately twenty feet) advocated by most European workers. The data presently available makes a rise of about ten feet seem reasonable for the Gulf Coast.

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