

# SOIL SURVEY OF THE NEW ORLEANS AREA, LOUISIANA.

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## LOCATION AND BOUNDARIES OF THE AREA.

The New Orleans area comprises a land area of about 410 square miles and is included within the parallels of  $29^{\circ} 50'$  and  $30^{\circ} 5'$  north latitude and  $90^{\circ}$  and  $90^{\circ} 30'$  west longitude.

Parts of five parishes are included within the limits of the area: Orleans, Jefferson, St. Charles, and St. John the Baptist, and a very

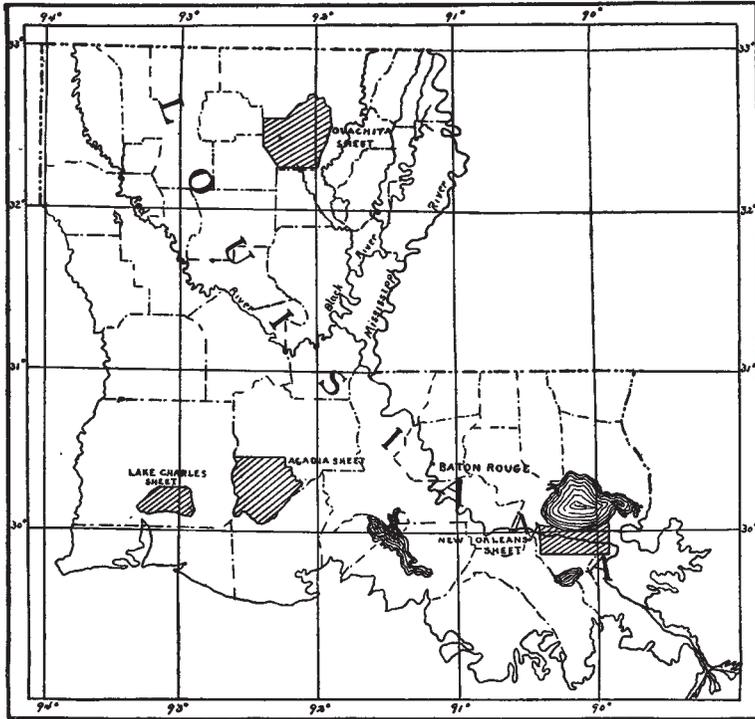


FIG. 19.—Sketch map showing location of the New Orleans area, Louisiana.

small corner of Plaquemines. Of the first three named practically all of the land under cultivation at the present time is included within the bounds of the area.

The Mississippi River follows a winding course through the area, with a general eastward direction, and it is to a narrow strip along

this river that the agricultural interests of the area are now confined. The profitable production of rice in Louisiana has stimulated the interests of the people, both the present owners and prospective investors, in the marshy lands which cover so extensive an area in the delta region, and, besides the usual investigations of the cultivated land, this survey included an investigation into the productiveness of these lands and their adaptation to different crops.

On the east, or rather at this point the north, bank of the Mississippi is situated the greater part of the city of New Orleans. Algiers and Gretna, now a part of the incorporation, are situated on the opposite bank. New Orleans is rapidly growing in population, wealth, and commercial importance. The population is over 300,000 in summer and the winter population is not less than 50,000 greater. The commanding position of New Orleans as a port is being realized more fully every year and the volume of the exports from the city has far outstripped in proportion the growth of population.

#### HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

In 1699 an expedition under the command of Iberville was sent from France to take possession of the vast territory of Louisiana, annexed by La Salle in 1682. The first settlement was located at Biloxi, in what is now the State of Mississippi. From this place Iberville and his brother Bienville explored the surrounding country as far north as the Red River. On one of these explorations of Lake Pontchartrain, in 1718, Bienville noticed a small stream which led out in the direction of the Mississippi River. He ascended it as far as he was able and encamped on the high ground. This he decided was the site for the settlement needed on the Mississippi. There were two reasons for this selection; the ground was higher and the stream called the Bayou St. John furnished a means of communication by water with Biloxi and the Gulf of Mexico through Lake Pontchartrain, otherwise than by the river, which in times of flood was difficult to ascend; but the site did not prove as advantageous as Bienville expected. With the small force at his command the work of clearing the swamp about the city proceeded very slowly, and for several years New Orleans was but a squalid village. In the second year of its existence it was inundated by high water in the Mississippi, and it was necessary to build dikes for protection. The city as originally planned comprised only eleven squares of river front, but in the early French days houses were built back on the roads that led toward Lake Pontchartrain and Bayou St. John.

The French encountered in Louisiana the same difficulty in the character of their settlers which the other nations met in the settlement of their American possessions. The only emigrants that could be sent

to New Orleans were galley slaves, adventurers, and gold seekers, excited by the representations of John Law and the Mississippi Company, together with a few hunters and trappers who drifted down from Canada. Bienville clearly saw that the permanent prosperity of the colony must be founded on agriculture; but with such a population the heroic man almost despaired of his task. In 1735 he wrote: "I neglect nothing to turn the inhabitants to agricultural pursuits; but in general they are worthless, lazy, and dissolute, and most of them recoil from the labor necessary to improve lands." The only remedy for this state of affairs was the employment of slaves. The Indian war, which disturbed the prosperity of the colony for many years, had given the French the opportunity to take Indian slaves, but they proved so inefficient that they were traded to the West Indies for negroes. The negroes, who had been imported steadily since the foundation of the colony, were now brought in in such numbers that by 1736 they comprised more than half the colony. A desirable class of settlers now came in. Rice, tobacco, and indigo were cultivated with success, and the fig and orange thrived everywhere. Bienville wrote in 1735: "The cultivation of cotton is advantageous, but the planters experience great difficulty in clearing it from the seed." Plantations were gradually established on both sides of the river above and below the city, and it soon became necessary to limit the extent of river front that could be taken by each planter. A party of Germans who came down the Mississippi and were unable to secure passage to Europe were granted land about 30 miles above the city. This has since been known as the German coast. The Jesuits were granted a tract of land near the city in 1727, on condition that they educate the youth of New Orleans. Here they ran a model plantation; and when the order was expelled in 1763 their plantation was sold for \$180,000, a very large sum for those days. To these Jesuit fathers Louisiana is indebted for the introduction of the orange, fig, sugar cane, and indigo. Sugar cane was introduced in 1751, and while no one was successful in extracting the sugar, the cane was either sold on the market or used in the manufacture of a vile kind of rum called "tafia."

In November, 1762, by the treaty of Fontainebleau, Louisiana was ceded to Spain. The act was so violently opposed by the colonists that the governor sent to take possession was not allowed to enter the city, and it was not until 1769 that the colony was peacefully taken by Governor O'Reilly. Though the relationship between the colonists and the new owners never became cordial, it was peaceful, and it is generally conceded that Louisiana secured a mild and efficient government under the Spanish administration. The greatest difficulty was that trade was almost confined to the Spanish markets, while other Spanish colonies had monopolies in nearly all the products that Louisiana could furnish.

The cultivation of tobacco was discontinued. The tedious work of separating the cotton lint from the seed made that staple unprofitable. The planters were forced to depend upon indigo as a money crop. Low prices soon brought them to ruin. It was at this time that sugar was first made in paying quantities. The pioneer in this industry was Etienne De Bore, who in 1794 planted his first crop near the present site of the sugar experiment station. This crop sold for \$1,200 and De Bore was hailed as the "savior of Louisiana." All the large planters erected sugar houses and a new era in the agricultural history of Louisiana was inaugurated.

On October 1, 1800, Louisiana was secretly ceded to France. After its sale to the United States Laussat took possession publicly, and on December 20, 1803, just twenty days later, by Napoleon's orders the vast territory was transferred quietly to the possession of the United States. In 1812 the present State of Louisiana was admitted to the Union. The city of New Orleans became a great commercial center. In both the war of 1812 and the civil war it was an objective point. In the former war the battle of New Orleans was fought just below the limits of the present area.

The cultivation of rice was introduced into Louisiana early in the nineteenth century, probably from the Carolinas, and has since held its place as one of the main industries of the region. The attention the crop has received from the planters has varied as it has come into competition with more profitable crops, but good returns have, as a rule, been realized.

Cotton was never produced along this part of the river. The soil when first cultivated giving an excessive growth of stalk and too little cotton and the difficulty of giving the soil adequate drainage were the chief causes for the neglect of this staple.

The trucking and dairying industries are assuming important proportions near the city. Many of the Italians who began as laborers on the plantations later went into the trucking business to supply the city market. Since rapid transportation has enabled them to send their surplus to northern markets the trucking industry is reasonably certain of profit. There are a number of small dairies near the city which are said to be very successful, but as yet they have not been able to supply the increasing local demand for dairy products.

#### CLIMATE.

Weather observations have been made during a period of many years at two stations within the area. The location of the Weather Bureau station is at the custom-house on Canal street. Accurate records have also been kept at the sugar experiment station at Audubon Park. These stations are only  $4\frac{1}{2}$  miles distant, yet there is a considerable difference in climatic conditions between the two places. The

temperature is shown to be on an average 1.1° cooler and the average annual precipitation is 2.64 inches greater at the latter place.

The following table shows the normal monthly and annual mean temperature and precipitation:

*Normal monthly and annual temperature and precipitation.*

Month.	New Orleans.		Sugar experi- ment station.		Month.	New Orleans.		Sugar experi- ment station.	
	Temper- ature.	Precipi- tation.	Temper- ature.	Precipi- tation.		Temper- ature.	Precipi- tation.	Temper- ature.	Precipi- tation.
	°F.	Inches.	°F.	Inches.		°F.	Inches.	°F.	Inches.
January .....	54.0	4.71	51.8	3.95	August .....	82.4	5.68	81.5	6.10
February ....	57.3	4.52	55.0	5.78	September ..	78.7	4.71	77.9	5.63
March .....	62.7	5.00	61.5	4.36	October .....	70.5	3.11	68.4	2.68
April .....	68.8	5.17	68.2	4.80	November ...	61.4	3.94	59.9	3.46
May .....	75.1	4.28	74.8	4.25	December ...	55.8	4.18	53.7	4.52
June .....	80.4	6.51	80.4	8.16	Year ..	69.1	58.01	68.0	60.65
July .....	82.4	6.20	82.4	6.96					

The climate of the area is that of the subtropics. The summers are long and uniformly hot, but without dangerous and long-continued periods of excessive heat. The proximity of the Gulf of Mexico exerts a modifying influence upon the climate. Cool breezes spring up during the heat of the day and there is always a fall in temperature at night, which makes the summer much more endurable here than in many localities farther north. It will be seen by reference to the table above that the dry months are October and November and that the rainy season occurs during the months of June, July, and August. This distribution of rainfall during the hot summers is extremely favorable to the growth of sugar cane and rice. A dry winter and spring favors the operation of breaking and planting. Warm, humid summers promote the rapid advancement of both crops, and cool, dry autumns are calculated to increase the sugar content of cane as well as to facilitate the work of harvesting. The growing season is long enough, with certain rare exceptions, to allow the maturing of every crop grown in the area and even to allow three crops per year of certain truck where such intensive farming is desired.

During a period of ten years, according to records kept at New Orleans, the occurrence of killing frosts in the spring has ranged from January 30, in 1897, to March 27, in 1894, and the first in fall from November 11, in 1894, to December 27, in 1902. The average dates of occurrence are, for the spring February 14 and for the fall December 7. This gives for even the tenderest of plants an average growing season of nearly ten months.

A most serious check to the attraction of a desirable class of immigrants to this section is the impression which has gotten abroad as to its unhealthfulness. That this idea had some foundation in the past

can not be denied, but such a condemnation can not now be applied to the State as a whole or to this particular vicinity. The records of the medical board of New Orleans show that the city has an excellent health record for a city of its size. A system of modern sewerage will soon replace the unsanitary contrivances of the past, and the death rate will no doubt be further decreased.

Outside of the city sanitary conditions are naturally much better. The dwellings of both the owners and the tenants of the plantations stand on the higher land along the Mississippi River, where there is adequate natural drainage. Notwithstanding the proximity of the swamps and standing water, malaria, though occasionally occurring, is not dreaded. Until within the last few years epidemics of yellow fever caused frequent alarm, but this disease has now been thoroughly eradicated, and with the methods of treating the disease and preventing its spread it is not to be dreaded as formerly, even if it should again appear.

#### PHYSIOGRAPHY AND GEOLOGY.

Geologically this region is one of extreme simplicity. The whole area forms a small part of the extensive Delta of the Mississippi River and owes its late reclamation from the Gulf of Mexico to the vast amount of sediment brought down by the river and distributed by frequent overflows. These sediments, in the vicinity of New Orleans, are of a great and at present unknown depth. The unsuccessful attempts that have been made to find oil by sinking wells near the city have only served to indicate that several thousand feet would have to be penetrated before strata of any great age could be encountered. It would not be strictly correct to apply the term alluvium to this sedimentary mass as a whole, for the formation has been modified both in composition and structure by the presence and action of the Gulf waters. Marine fossils are sometimes found quite near the surface, and saline deposits make their presence felt in some of the more recently formed soils.

The materials brought down by the river, either in suspension or rolled along on the bottom of the river bed, range in texture from fine sands to fine clays. They are largely of mineral origin, having a surprisingly small amount of organic matter, so that the high percentage of organic matter in the soils must have been derived from the progressive incorporation of local vegetation as the soils were built up.

The physiography of the area is that characteristic of a delta region. The highest ground, which in this case never exceeds 15 feet above sea level, occurs immediately along the river and serves in times of ordinary water level as a natural levee to confine the river to its channel. Another peculiarity of the physiography is the system of distributary channels which in former times served to carry off the surplus water in times of overflow. The bayous were large enough to be used

as commercial waterways by the early settlers of the area, but nearly all have been allowed to fill naturally or have been filled artificially by planters. The Tchaptoulas Bayou has almost entirely disappeared, while Metairie and Gentilly bayous are fast being filled by silt.

SOILS.

Six soil types, including Muck, have been mapped in the New Orleans area. All of these, with the exception of the Muck and Galveston clay, belong to the same general series in regard to origin and method of deposition and have been correlated with the types found in the Yazoo area, Mississippi. Though there are variations in texture and topography, they have not been deemed of sufficient importance to necessitate the establishment of new types.

The names and areas of the several types are presented in the following table:

*Areas of different soils.*

Soil.	Acres.	Percent.	Soil.	Acres.	Percent.
Sharkey clay .....	157,952	60.2	Yazoo loam .....	18,112	6.9
Yazoo sandy loam .....	41,600	15.8	Galveston clay .....	5,504	2.1
Muck .....	21,056	8.0	Total .....	262,592	.....
Yazoo clay .....	18,368	7.0			

YAZOO SANDY LOAM.

The Yazoo sandy loam consists of a fine brown sandy loam, having an average depth of 15 inches, underlain by a lighter colored sandy loam, with a less amount of the finer materials and a decrease of organic matter with the depth. The top soil may vary widely in texture, ranging from a sticky sand to a somewhat plastic sandy loam, but there is a uniformity in the texture of the subsoil wherever found. In the largest area of this soil, which occurs around the Bonnet Carre crevasse, the heavier top soil is generally absent, but here the organic matter makes a distinction between soil and subsoil. Along the low ridges on which this soil is usually found it has a depth of only a few feet, invariably passing below into the heavy clay which underlies all other formations. In the Bonnet Carre extension of this soil, however, the waters rushing through the crevasse washed out a basin and piled up the sands to a depth of 10 feet or more.

The Yazoo sandy loam, occupying as it does the crest of the low ridges immediately along the river, is furnished both by its position and by its porous character with comparatively good natural drainage. This drainage, however, is not toward the Mississippi, but away from it toward the lower lying swamp areas, where it is led through an intricate system of sluggish bayous to the nearest lakes and in the

end to the Gulf. The fall for the first mile or two is sufficient in ordinary seasons to remove the water rapidly enough to meet the requirements of the crops, while in very rainy weather the surplus water can be readily removed by surface ditches. Tile drainage has been tried with the view of draining the plantations as a whole, but it has not been successful for the reason that an abrupt change in rate of descent occurs when the levels of the swamp areas are reached and the waters thus checked drop their burden of silt and the tiles become choked with it.

The Yazoo sandy loam is one of the most recently formed soils of the area. The larger tracts of this type shown on the soil map have been deposited within the last thirty years. The type is purely alluvial and represents the coarsest phase of the series that has been derived by the process of assortment from the varied sediments of the Mississippi River in times of overflow. Before the construction of an extensive system of levees was undertaken the floods would spread out through the delta, and when the waters lost their carrying power, through a slackening of velocity, they dropped their various-sized sediments in the same proportion. The hold was first lost on the coarser sands and they were deposited along the river bank. In this way they gradually formed a natural levee, which served to protect the country from occasional smaller risings of the river. Since the inauguration of the levee system this deposition of coarser soils has gone on only when a break has occurred, but then locally at a rate never before known. A vast volume of water, passing with great rapidity through a comparatively narrow crevasse and being checked less suddenly, has deposited these sands many miles from the river. The most notable example in the present area is found at the Bonnet Carre, where the river waters, passing for years through a crevasse, deposited a layer of sand over a territory many square miles in extent and of depth sufficient to reclaim much of it from low swamp conditions.

These recent soils, derived from rich lands to the north and as yet unhurt by injudicious tillage, are naturally very productive, and this fact, combined with their excellent drainage and easy tillage, have caused them to be highly valued by the sugar planter. The soils of the large sugar plantations here and in the longer cultivated parts of the area are almost invariably found to be of this type. Even where the top soil is of a heavy character the subsoil is found to be sandy and porous enough to permit adequate drainage for the cane crop. Cane requires a large amount of moisture and thrives best on a soil retentive of moisture, and were it not that the question of drainage is the one of overshadowing importance, the Yazoo sandy loam would not be so highly regarded by the sugar grower as the heavier soils of the area. The type also has the advantage of being a warmer soil and an early growth of the cane is secured, but later in the summer droughts may

result in a failure of the crop. Drainage, however, is so important that this soil will continue to be the most valuable for cane.

The yield of cane varies from 10 to 40 tons per acre. This variation is dependent on temperature, rainfall, drainage, and cultivation. Corn is grown to a considerable extent, but usually only to rest the land from cane. The yield, with the indifferent cultivation bestowed on this crop, is 25 to 40 bushels per acre. Rice is cultivated to some extent on the very low areas, but this soil is not adapted to rice on account of its inability to retain an excess of water on the surface. Truck is grown extensively for the early market, and the Yazoo sandy loam is the soil of the area best adapted to this purpose. Onions, eggplant, tomatoes, and cabbage are the vegetables which succeed best.

The following table gives mechanical analyses of this soil:

*Mechanical analyses of Yazoo sandy loam.*

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.06 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
9278	2 miles E. of Laplace	Loose sandy loam, 0 to 20 inches.	1.49	0.00	0.04	0.04	4.40	47.32	44.16	3.44
9276	1 mile SE. of Shrewsbury.	Fine sandy silty loam, 0 to 8 inches.	2.36	.44	1.24	.82	6.76	43.90	41.74	5.04
9279	Subsoil of 9278.....	Fine sandy silty loam, 20 to 36 inches.	1.37	.00	.10	.06	3.80	35.66	55.54	4.40
9277	Subsoil of 9276.....	Sandy silty loam, 8 to 36 inches.	2.08	.70	1.74	.88	7.18	28.38	55.16	5.42

The following samples contained more than one-half per cent of calcium carbonate (CaCO<sub>3</sub>): No. 9276, 3.59 per cent; No. 9277, 3.08 per cent.

YAZOO LOAM.

The Yazoo loam is quite uniform in texture and general characteristics. The soil to a depth of 5 to 7 inches is a yellow or light-brown silt and except where plowed too wet is loose and powdery. Where plowed wet it flocculates, and has the appearance of being a coarser soil than a closer examination shows it to be. The subsoil is a brown or drab clay or heavy silty loam of a rather tenacious character.

The Yazoo loam occupies areas of peculiar shape and position. It makes up, with the exception of a few detached areas, a series of long ridges, which are independent of the other soils of the area. The best developed of these is Metairie Ridge, which takes its rise just east of Kenner and extends without a break to the Bayou St. John within the city of New Orleans. Across the Bayou St. John the formation is continued under the name of Gentilly Ridge, which extends beyond

the limits of the present area. Across the Mississippi River two of these ridges begin near Boutte and extend southward beyond the boundary of the area as a strip of habitable land running through the low and almost impenetrable swamp.

One of these ridges has been utilized by the engineers of the Southern Pacific Railroad in extending their roadway across the swamp. The soil of these ridges is more variable and becomes coarser in places than the Metairie Ridge silts, but they have in general the same powdery, loesslike appearance.

While these ridges are only a few feet above the level of the swamps which surround them, this slight elevation is sufficient to make them valuable farming tracts. They owe their origin and elevation to a process even more simple than that which has built up the ridges of coarser materials along the Mississippi River. In the early days of the French domination sluggish bayous flowed along the course of these ridges. They were open and large enough to admit the passage of boats, and in times of overflow they served as distributary channels for the surplus river water. The velocity of the current at such times was barely sufficient to convey the silts and clays. When the bayous overflowed their banks the silts were deposited to an average distance of one-half mile on each side of the bayous, and low ridges were gradually built up on both sides of the stream. That these ridges must have formed almost at sea level is evident from the accumulation of alkali along the top of the ridge. This was probably formed through the inclosure and subsequent evaporation of ponds of salt water. Some of these salt spots are several acres in extent, and in places entirely free of vegetation. A chemical analysis of the soluble salts contained in a sample of this alkaline soil taken on Metairie Ridge, near the Bonnabel place, gave the following results:

*Chemical analyses of salts in alkali soils.*

Constituent.	9280. Metairie Ridge, 1 1/4 miles NW. of New Orleans, loose silt, 0 to 6 inches.		Constituent.	9280. Metairie Ridge, 1 1/4 miles NW. of New Orleans, loose silt, 0 to 6 inches.	
	9281. Under 9280, heavy silty loam, 6 to 36 inches.	Per cent.		Per cent.	9281. Under 9280, heavy silty loam, 6 to 36 inches.
Ions:	<i>Per cent.</i>	<i>Per cent.</i>	Conventional combinations:	<i>Per cent.</i>	<i>Per cent.</i>
Calcium (Ca).....	13.91	8.90	Calcium sulphate (CaSO <sub>4</sub> )	5.07	21.12
Magnesium (Mg).....	7.33	11.11	Potassium chloride (KCl)	5.63	7.77
Sodium (Na).....	10.15	6.66	Sodium chloride (NaCl)	24.82	12.23
Potassium (K).....	3.00	4.44	Sodium bicarbonate (NaHCO <sub>3</sub> )	1.50	8.90
Sulphuric acid (SO <sub>4</sub> ).....	3.57	14.44	Calcium chloride (CaCl <sub>2</sub> )	34.22	6.66
Chlorine (Cl).....	60.92	47.79	Magnesium chloride (MgCl <sub>2</sub> )	28.76	43.32
Bicarbonic acid (HCO <sub>3</sub> )..	1.12	6.66	Per cent soluble .....	1.06	.18

These salts are a source of irritation to the farmers, as they ruin otherwise valuable land and destroy the regularity of the fields. The only remedy that can be suggested is thorough drainage. If this can be secured the heavy rains should in course of a few years remove the excess of soluble salts.

The Yazoo loam near the city is devoted to market gardening and to dairies and nurseries. The nurseries make a speciality of citrus and other semitropical fruits and flowers. The market gardeners grow cabbage, eggplant, and okra most successfully, and Metairie Ridge is also famous for its cantaloupes.

The ridges on the west side of the river are too far away from the city for these branches of agriculture. Here and on the small areas of the type cane and corn are grown. Cane meets with fair success, and the best corn of this area is to be found on the smaller areas of this soil.

The subjoined table shows analyses of typical samples of the Yazoo loam:

*Mechanical analyses of Yazoo loam.*

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.06 mm.	Silt, 0.06 to 0.006 mm.	Clay, 0.006 to 0.0001 mm.
				P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
9270	1½ mile E. of Boutte.	Silty loam, 0 to 7 inches.	1.73	0.00	0.10	0.08	0.42	7.68	79.50	12.22
9272	¼ mile N. of Shrewsbury.	Brown silty loam, 0 to 7 inches.	1.96	.00	.20	.24	.84	9.48	74.48	14.40
9274	2¼ miles S. of Ameshville.	Brown silty loam, 0 to 8 inches.	1.59	.00	.16	.12	.60	12.12	69.56	17.44
9273	Subsoil of 9272.....	Heavy silty loam, 7 to 36 inches.	1.45	.00	.12	.08	.60	11.42	68.00	19.56
9275	Subsoil of 9274.....	Heavy silty loam, 8 to 36 inches.	.80	.08	.32	.40	1.12	6.56	71.64	19.88
9271	Subsoil of 9270.....	Brown silty clay loam, 7 to 36 inches.	1.06	.00	.18	.22	2.60	15.04	43.88	37.68

YAZOO CLAY.

Yazoo clay consists of a surface soil of dark-brown, silty, clay loam having a depth of 6 inches and underlain by a brown or waxy clay. The small percentage of fine sand and silt has modified the tenacity of the top soil and rendered it more easy of tillage than the Sharkey clay of the lowlands, but the subsoil is almost as tenacious as that of the Sharkey clay. There is a tendency in places to sun crack when drying, but this is not a distinctive feature of the soil. The cracks are neither so long nor so deep as in the Sharkey clay.

The Yazoo clay is found in small strips between the stretches of Sharkey clay and the more sandy soils of the river front. The type is so uniform and passes so gradually into the heavier Sharkey clay that exact definition of its boundaries is extremely difficult. The topography of this type is level and only slightly elevated in many places above the Sharkey clay areas of swamp. The natural drainage is necessarily poor, and the impervious nature of the subsoil contributes to the difficulty of artificial drainage.

The Yazoo clay has been slowly formed as a still-water deposit from the overflow waters of the Mississippi after the current had been checked, and the occasional addition of slightly coarser materials has served to improve the structure of the resulting clay.

The type is of high productiveness and well adapted to the agricultural industries which it supports near the city, namely, dairying and growing of late truck. Grass, which grows luxuriantly on this soil without any care, affords good pasture and a fair grade of hay. Egg-plant, tomatoes, and cabbage are grown by many gardeners near New Orleans and at several shipping points along the railroads.

Away from the city the low-lying areas of this type are devoted to the cultivation of rice. The productiveness of the soil and its retentiveness of water make it well adapted to this crop wherever the land is so situated as to allow irrigation.

Corn is grown on the more elevated areas of this type with success. The yield depends on the cultivation given the crop and ranges from 20 to 40 bushels per acre. Much of the corn is sold green in the ear at a good profit.

The following table shows the results of mechanical analyses of samples of this type:

*Mechanical analyses of Yazoo clay.*

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
				P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
9268	½ mile S. of Algiers..	Heavy clay loam, 0 to 7 inches.	2.62	0.10	0.42	0.40	1.46	6.22	50.70	40.40
9266	½ mile S. of Carrollton avenue and Applestreet, New Orleans.	Heavy clay loam, 0 to 7 inches.	1.14	.02	.18	.30	1.40	1.12	81.64	65.30
9269	Subsoil of 9268.....	Clay, 7 to 36 inches..	.94	.06	.34	.22	1.80	11.24	45.26	41.08
9267	Subsoil of 9266.....	Heavy clay, 7 to 36 inches.	.95	.10	1.10	.58	2.32	2.80	47.54	45.48

## SHARKEY CLAY.

The Sharkey clay is the heaviest soil of the New Orleans area. It is the most extensive type; and as only a small proportion of it is under cultivation, the subject of the reclamation of the large unused area is attracting considerable attention.

The soil is a heavy black clay to a depth of 5 or 6 inches. The dark color is due to the large content of organic matter which has been derived from the heavy growth of vegetation as the clay was slowly deposited. This decayed vegetation has had a marked beneficial effect on the structure of the soil by causing it to break under the plow into little blocks and to assume a much more favorable condition than is usually possible with this type. The subsoil is a brown or drab waxy clay of a most impervious and tenacious character. The percentage of organic matter is much smaller than that of the subsoil.

The Sharkey clay shrinks greatly upon drying, and the surface of a drying field is always checked by large sun cracks.

The Sharkey clay occupies the entire land surface of the area, with the exception of narrow strips along the rivers and bayous, where the swifter overflow waters have built up natural levees of coarser sediments, and excepting also considerable areas where it has been covered so completely by decayed vegetation that a muck type has been established.

The vast area occupied by Sharkey clay was originally a worthless swamp, and much of it yet remains so. The elevation of this land is only a few feet above the level of the Gulf of Mexico. The drainage is away from the Mississippi River toward the series of lakes a few miles back and thence to the Gulf. The drainage of so impervious a soil with so slight a descent in elevation is naturally difficult, and requires that every avenue for the passage of water should be as direct as possible. As it is, sluggish bayous spread out through the swamp and reach the lake through a network of ramifications. At the rear of the larger plantations pumping plants are necessary to drain the comparatively small areas of Sharkey clay under cultivation, and straight ditches carry the water to the lakes. In addition a number of canals, dug for sewers or navigation, penetrate the Sharkey clay swamp areas, but as no laterals have been cut they have little effect in draining them.

The origin of this soil is due to the process of assortment already described, a process which continues at intervals at the present time. When a break occurs in the levees along the river front, the waters of the crevasse, after losing their coarser materials, spread out over the lowlands, holding in suspension the very fine clays, which settle down and become a part of the soil.

The Sharkey clay areas are for the most part forested. The exceptions are those comparatively small areas in cultivation and the

treeless prairies which cover a considerable area in the southern part of the present survey. In the very wet, poorly drained tracts there is an almost impenetrable growth of cypress, willow, maple, water oak, and sometimes ash. On the better-drained portions the woods are more open and the palmetto flourishes near the border. The supply of easily accessible cypress timber has been exhausted, but there is still a considerable industry in getting cypress for ties and lumber from the swamp tracts more difficult of access. No hauling can be done in the deep swamps, but the logs are rafted out through shallow canals. A number of persons make a living by gathering moss from the trees of the swamp.

The difficulty of clearing and draining these lands, as well as the difficulty of tillage, combined with the cheapness of other land in this section, has tended to retard the work of reclaiming these extensive swamps. The Sharkey clay was not especially adapted to cane and cotton and was no temptation to producers of these commodities, but the increased interest of late years in the production of rice has given a new value to this soil, and if the problem of drainage can be cheaply and successfully solved the soil is admirably adapted to the production of this crop. Near New Orleans the reclaimed areas are devoted to the dairy business and to market gardening. The fertility of Sharkey clay is almost inexhaustible, and when well drained it is adapted to any crop which requires a fertile clay soil. The crops most profitably grown near New Orleans are onions, cabbage, egg-plant, and tomatoes.

The following analyses show the texture of samples of the Sharkey clay:

*Mechanical analyses of Sharkey clay.*

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
9264	½ mile S. of Algiers.	Black clay, 0 to 6 inches.	1.30	0.16	0.80	0.56	2.02	7.30	51.18	37.76
9262	½ mile W. of Algiers.	Heavy clay loam, 0 to 6 inches.	1.54	.02	.64	.60	3.14	2.80	37.74	54.72
9265	Subsoil of 9264.....	Clay, 6 to 36 inches.	.76	.02	.08	.12	1.48	3.22	39.42	54.98.
9263	Subsoil of 9262.....	Stiff clay, 6 to 36 inches.	.55	.00	.06	.14	2.04	2.26	26.46	68.50

MUCK.

Between the Mississippi River and Lake Pontchartrain are extensive areas where the dense growth of vegetation has decayed and accumu-

lated on the surface of the Sharkey clay to a depth of from 1 foot to more than 3 feet. This more or less decomposed mass is made up of the trunks and leaves of trees, but more largely of the rank weeds and grasses which flourish in this locality.

The extensive tracts covered by the Muck are poorly drained and almost impenetrable. The only places where this type can be seen under any favorable conditions of drainage are between the drainage canals which lead from New Orleans to Lake Pontchartrain. Clearings have been made and it has been demonstrated that the Muck can be reclaimed, but so far none of it has been cultivated. The Muck in many of the localities in which it was observed is finely divided and well decomposed and should be well adapted to the cultivation of those crops which thrive on the peaty soils.

#### GALVESTON CLAY.

The Galveston clay consists of a mucky mass of vegetation in various stages of decay, interspersed with a fine clay of drab color. Along the borders of the marshy prairies covered by this type the soil closely approaches in texture the Sharkey clay, and passes into a subsoil similar to that of the Sharkey clay at lower depths, but the lower lying strips nearer the bayous are little more than peat bogs to a depth of more than 3 feet.

The Galveston clay forms a broad border along the Bayou des Allemands, opening out a short distance above the town of Des Allemands to a width of several miles outside of the present area, with an arm extending northward toward the town of Hahnville. The latter extension follows the course of a sluggish bayou with its many ramifications through the marsh.

The topography of the type is that of a low marsh but little elevated above sea level. Water stands over much of the surface at all times in pools and channels and renders the marsh almost impenetrable except by boat. In times of flood or when a levee breaks along the Mississippi above and the waters escape in this direction the marsh is entirely covered by water.

The areas occupied by this type are entirely treeless and devoid of other vegetation, except sparse marsh grasses which have little value for grazing. This absence of vegetation, in such contrast to the dense swamp growth on the Sharkey clay, is due largely to the brackish nature of the water which ascends the bayous at high tide, and perhaps in part to the peaty nature of the soil, with its poor drainage.

These marshy areas have no agricultural value at present, for their slight elevation above even the level of low water renders any plan for drainage very difficult.

## RECLAMATION OF SWAMP.

The advisability of attempting to reclaim the swamp areas of the Mississippi Delta is exciting public consideration. Capitalists stand ready to make the necessary outlay for the improvement of these lands when it shall be shown that the cost of drainage and clearing is a profitable enterprise and that the lands will be commercially valuable when ready for agricultural operations. The low situation of these lands above the sea and the dead level of the surface will make drainage a difficult problem. The plans for drainage and the cost can only be calculated by the hydrographic engineer. It is only desired here to discuss the agricultural value of these lands after reclamation.

The convenience of the area to New Orleans and the excellent transportation facilities, both by land and water, guarantee a substantial cash value for the land if the soil is productive and adapted to profitable crops. The soil which will likely be found over the entire swamp area, of which the area surveyed forms only a small part, is Sharkey clay, overlaid in some localities by Muck. The Sharkey clay is a soil of the highest productiveness and adapted to purposes of general farming and dairying wherever adequate drainage can be secured, but if any concerted effort is made in the near future to drain large areas it will be under the stimulation of the value the rice-growing industry has given level and easily irrigated lands. The Sharkey clay is well adapted, both by position and texture, to the cultivation of rice. The flat areas, below the level of the Mississippi for a good part of the year, can be cheaply irrigated, and the impervious character of the subsoil makes it extremely retentive of the water thus introduced. The problem of draining off the surplus water, especially during rainy seasons, is one of more expense perhaps than irrigation, and can only be solved by concerted efforts and by the expenditure of large sums in general drainage plants. Sooner or later the Delta swamps will be brought under cultivation. Whether this shall be accomplished in the near future or not is only a question of the cost of improvement and the market value of the land after reclamation.

## AGRICULTURAL METHODS.

The two crops, rice and cane, have since the beginning of the nineteenth century engaged the attention of the south Louisiana planter, and it is safe to say that in no agricultural community of this country has there been a keener intelligence displayed in methods of cultivation and in the preparation and marketing of crops. The cane crop is a forced one in this northern latitude, and must be hastened to maturity by fertilization and the most skillful management of the soil during the period of growth.

Sugar cane (*Saccharum officinarum*) is simply a gigantic grass. Its roots, like all grasses, are fibrous and lateral and do not penetrate the soil to any great distance. This limited ability of the cane to reach out for the elements necessary for its growth makes the careful manipulation of the soil, both before and after planting, of the utmost importance. A few fertile seeds have been grown from cane in tropical countries, but all efforts to grow seed in Louisiana have resulted in failure.<sup>a</sup> The cylindrical stalk of the cane is divided at intervals of several inches by joints containing a bud or eye, which sprouts when planted, and this is the only means by which the plant can be propagated anywhere on a commercial scale.

A kind of short rotation is practiced in the cultivation of cane. On land designed for cane, corn is planted in the previous spring. When the corn is laid by, cowpeas are thickly sown between the rows, and when the corn is gathered the rank pea vines are either turned under or are cut for feed and the stubble turned under. The land is thrown into beds 5 to 7 feet wide and the middles are broken out and quarter drains opened to secure good drainage. Both fall and spring planting are practiced, but fall planting is generally favored. The method of planting is to lay the whole stalks of cane along continuously in the row and cover to a depth of 2 or 3 inches with earth. About 2 tons of cane are required for seeding when one continuous stalk is used, but even with this heavy expense for planting the stand is often deficient on account of the eyes which do not germinate, and many planters prefer to plant two running stalks. When a stand has been secured and the young shoots appear above the ground in the spring, the first operation is to remove the excessive earth which has protected the cane from the cold. Fertilizers are soon applied and the soil is returned to the plants and the middles are opened out. The drains are also attended to, that the fields may not be flooded by excessive rains.

Cane requires frequent cultivation during the period of early growth. Disk cultivators are used to pulverize and throw the soil to the cane, and heavy disk or shovel cultivators are needed to break out the middles. At the "lay by" some use large disks and follow by a middle cultivator for throwing the soils to any desired height. The cane is usually laid by in July. The sugar content has usually developed sufficiently to permit grinding to begin by November 1. The grinding season is one of unremitting activity on the sugar plantation and every laborer obtainable is pressed into service. One of the greatest expenses in the industry is the cost of harvesting. The cane stalk is stripped of its leaves and cut by hand labor and thrown into the heap. The hauling of the cane to the sugarhouse requires large

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<sup>a</sup>Sugar Cane, William C. Stubbs.

mules and a strong cart. There are on the large plantations conveniences for transferring the cane to and from the cart, but no satisfactory harvester has yet been devised.

The treatment of the cane after it reaches the refinery is the interest of the manufacturer rather than of the agriculturist, but as the Louisiana planter must be both, the processes may be briefly described here. After the juice has been pressed from the cane by a series of heavy rollers, the solid refuse or baggasse goes to the furnace for use as fuel, and the juice is led into a machine or tank for treatment with sulphur dioxide. This process bleaches the juice, helps to remove impurities, and has a preservative effect upon it. It is then run into huge vats, where it is heated and the impurities removed. The juice is now ready to boil down into sugar. This is done by evaporating in a vacuum boiler until granulation sets in. Some of the juice refuses to crystallize, and in order to remove it from the crystallized portion the mass is transferred to a sievelike centrifugal and the sirup thrown off by the rapid revolutions of the machine. The refractory sirups are reworked two or more times, and inferior grades of sugar secured. The final residue after all these processes is a black burnt molasses, which is utilized in the arts.

The cultivation of rice is confined to the more level areas along the river and to areas where the soil is generally of heavy texture. The land is well broken in the fall, and reseeded, harrowed, and planted in the spring. Planting usually begins about the 1st of March, and by the middle of the month is in rapid progress. During the higher stages of the river in the early summer irrigation is had from the Mississippi River by gravity, the water passing over the levee through large iron pipes acting as siphons. When the river level falls below the suction level of the siphons, pumping is carried on by small plants. The favorite method is to simply raise the water to a reservoir on a higher terrace, from which the siphon can convey it over the levee to the field. One of the most expensive features in rice growing in this area is the removal of the weeds and water grasses from the growing crop. This is performed by hand, and is a very tedious and costly process, costing usually from \$8 to \$10 an acre. Another disadvantage under which the river planter labors in competition with some other rice belts is that his land does not permit the use of machinery in harvesting. The land slopes so rapidly away from the river that frequent levees are required to hold the water, and on such narrow terraces machines can not be used to advantage. To offset these disadvantages the river planter has a most productive soil, a never-failing supply of pure, sweet water from a sediment-bearing stream for irrigation, and cheap transportation to market, and the quality of his rice is so well known that he is assured the highest market price.

## AGRICULTURAL CONDITIONS.

There are few parts of the United States so favored in natural resources as this part of Louisiana. Productive soils of varied textures suited to all crops of the warm Temperate zone, a warm climate, with a long growing season, abundant rainfall, and unsurpassed transportation facilities favor the enterprise of the planter. But with all these advantages the realization of a margin of profit is uncertain, and the planter in the production of favorite crops is keenly pressed by competition. In the past large fortunes have been accumulated by the sugar growers, and some of them still realize a considerable profit. The decrease in the price of refined sugar, to whatever cause it may be attributed, and the increase in the cost of production, due to the uncertainties of labor and other causes, have steadily reduced the profits in this industry. The planter has had to meet this reduction by the most careful management of his agricultural operations and by improving and enlarging his sugar houses, so that the profits to a large extent have been used for improvements on the plantation. In these expenditures for cheapening production the small producer has been forced to halt by lack of capital and either to sell his cane to the sugar house of a more wealthy neighbor or to enter some other branch of farming.

The large plantations are usually in the hands of hereditary owners or in the possession of capitalists who hold them for an income or for speculation. However owned, the plantations are directly managed by one or more overseers, whose duty it is to attend to the details of the field work and to direct and control the labor. These overseers are in the cane fields from morning till night, riding from one squad of workers to another. A large part of the valuable land, however, is not included within these plantations.

A majority of the farmers of the area are landowners, and the proportion is rapidly increasing. The greater proportion of the cultivated land of the parishes, parts of which are comprised in the survey, is included within the area surveyed. The proportion of owners is largest in the parish of Orleans, where the Italians are acquiring farms near the city.

Much of the rice farming is done on the cash tenant system. This is a favorite method with the people of Acadian descent, and a plan of cooperation is sometimes followed. A tract of land is rented by a clan of families. The leader or head of the family apportions to each worker his task, deals out provisions from a common fund according to the need of each family, settles all disputes that may arise, supervises the entire crop, and when the crop is harvested divides the profits. Cash rents range from \$5 to \$10 per acre, according to position of the land.

The price of land is difficult to state in the usual terms. The plantations are usually sold by river frontage. North of the Mississippi the tracts extend to Lake Pontchartrain. The land immediately along the river may be worth from \$100 to \$200 per acre, but the value decreases with decreased elevation until the almost worthless swamp lands are reached. The sugar plantations are sold with the sugar house, which represents an investment of from \$50,000 to \$300,000, and all of the farm implements and work animals. More than 100 mules are used on the large plantations, and, as they are the largest that can be found on the market, they add greatly to the cost of a plantation. Open land without this extensive equipment sells from \$40 to \$100 an acre, and a plantation taken as a whole ranges in value from \$10 to \$60 per acre, according to the value of the improvements and the amount of open land. A well-equipped sugar refinery would increase these estimates.

The majority of the laborers that subsist by daily wages are either negroes or Italians. Both races are usually employed on the sugar plantations. Some planters prefer the negro, others the Italian; but the latter seems to be gradually replacing the former. The labor is controlled by what is known as the "gang system," being at all times under the close supervision of the overseer. Day laborers get from 50 to 75 cents a day during the season of steady cultivation and from \$1 to \$1.50 during the cane-grinding season, when the work is severe and continuous. These laborers live in groups about the sugar houses, and have their houses rent free. Much skilled labor is employed on a sugar plantation during the grinding season as overseers, sugar boilers, engineers, and chemists.

As has already been stated, the principal products of the area are sugar cane and rice. The ordinary yield of cane ranges from 15 to 40 tons per acre, and the percentage of sugar is from 10 to 15 per cent of the weight at the mill. The smaller planters, who sell their cane to the refiners, get a price based on the selling price of sugar and the sucrose content of the cane.

Two varieties of rice—the Japan and the Honduras—are grown in Louisiana, but the latter variety is the favorite of the river planter because of its superior quality. The river rice has a high reputation in the markets, and goes to supply the best trade and to furnish seed for other rice-growing localities. This superiority may be ascribed to the character of the soil, the pure water used for irrigation, and the removal of inferior varieties when the water grasses are pulled.

Corn in this section may be regarded as a by-product in the production of cane and truck. Only one planter in the area grows corn extensively as a main crop. There is no reason why this should be the case except that the large profits sometimes realized in growing cane and rice make these crops more attractive to the planter than

corn. The yield of corn under the indifferent cultivation given it usually is from 25 to 40 bushels per acre.

Large quantities of early and late truck are produced in the vicinity of New Orleans and as far out as Kenner. Onions, egg plant, tomatoes, okra, and cabbage are grown in quantities to supply the local markets and leave a large surplus for shipment to northern markets.

The many transportation facilities through the area are well distributed. Six main lines of railway representing great systems radiate from the city—four to the north and east and two to the west. In addition, two short lines run southward, one on each side of the river.

The Mississippi River furnishes an avenue of transportation. While the completion of the railroads has stopped long-distance shipping by river, local steamers still run regularly and the planters ship much of their bulky produce by them to New Orleans. Rice is usually thrashed at the riverside by the power of the irrigation plant and loaded conveniently on the steamboats. A large amount of shipping reaches the city from Lake Pontchartrain and from the south through several canals.

New Orleans is the only market thought of in the disposal of sugar and rice. The preeminence that New Orleans has attained in the exchange of these commodities enables the planter to readily obtain the highest market price, and the proximity of the market enables him to quickly dispose of his products when prices are high. New Orleans is not a steady market for high-priced truck, but the demand is increasing. Many truck growers find it profitable to ship the bulk of their produce to northern markets during the winter, when fancy prices are obtained, and to sell in the local market during the summer. A number of small dairies are run near the city, but the demand for dairy products exceeds the supply. Few cities offer a more inviting field for experienced dairymen and truck growers.

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