

The topography of the uplands varies from slightly rolling to hilly, the hills being chiefly confined to those portions of topography which have a gravelly soil or a deep sandy mantle. The rougher topography of such areas is largely due to the resistance offered to weathering by the strata of ferruginous sandstone from which the deep sands are derived. The most conspicuous of these areas occur about 4 miles northeast of Hallsville, northwest of Eagleton, and a short distance east of Woodlawn. The topography of the northern part of the county is more diversified than that of the southern, and the southeastern part of the county is the smoothest of all. The greater part of the county is rolling. The divides are well defined and comparatively narrow. The drainage basins of the streams are fan shaped, narrowing as they approach the large streams, Little Cypress Creek and the Sabine River. The valleys are wide, open, shallow basins in their upper and middle courses and deeper with well-defined alluvial flood plains along their lower courses. The slopes facing the bottoms of Little Cypress Creek, of the Sabine River, and of the extreme lower courses of the larger tributaries of these streams, are usually short and steep. North and south from the main divide the general slope is not marked, e. g., the elevation at Marshall is about 400 feet, and that of Woodlawn, 9 miles north and 3 miles from Little Cypress Creek, is 310 feet above sea level.

The uplands are interrupted by strips of alluvial bottoms along the streams, varying from one-eighth mile to a mile in width and almost level. They are traversed by old stream channels and are subject to overflow.

The Red River eventually receives the drainage of the northern and eastern parts of the county, comprising nearly two-thirds of the survey, through Little Cypress Creek, Cypress Bayou, Caddo Lake, and their tributaries. The remainder, or southern part of the county, drains into the Sabine River. The main divide enters the county at a point almost due west of Marshall and follows an irregular easterly direction to a point near Scottsville, where it swings to the southeast and leaves the county near its southeastern corner.

The large tributaries of the Sabine River are, from west to east, Hall, Mason, Clarks, Hatleys, Potters, Eight Mile, and Socagee Creeks. The Red River system in this county comprises Little Cypress Creek and its chief tributaries, Caney and Bear Creeks from the north and Moccasin, Lawrence, Rays, and Grays Creeks from the south; Cypress Bayou, formed by the junction of little and Big Cypress Creeks, and its tributary, Haggerty Creek; Caddo Lake and its tributary, Harrison Bayou. Quapaw and Cross Bayous, in the eastern part of the county, drain into Cross Lake in Louisiana and thence into the Red River. A few streams in the northwestern part of the county flow into Big Cypress Creek.

The first permanent settlement in Harrison County was made in September, 1837, by a family from Louisiana. Until the late forties settlement was slow, but from that period until the Civil War there was a steady immigration from the Eastern and Southern States, particularly from Tennessee, Alabama, and Georgia. The county was formed from Shelby County in 1839 and was organized in 1842. The present population is composed of the descendants of the early settlers and a small percentage of northern and foreign-born people. In 1910 the population of the county was 37,243, a gain of 16.8 per cent over that of 1900. Of this number 36.5 per cent is white and the remainder colored. Although the colored population is found in nearly all parts of the county, it is more numerous in the eastern and southeastern sections, where the large estates were located prior to the Civil War.

A few grants of land in Harrison County were given by the Mexican Government prior to 1836, but the greater part of the land passed from public to private ownership between 1841 and 1872. The largest of these early grants contained about 4,000 acres. Others were for smaller areas ranging down to less than 100 acres. The grants were given by the Republic of Texas and later by the State of Texas for service either to the Republic or to the State.

Marshall, situated near the geographical center of the county, is the county seat and the largest city in northeastern Texas. It has a population of about 11,452 and is 148 miles from Dallas, 42 miles from Shreveport, and 67 miles from Texarkana. It is an important market and shipping point for farm products and a local distributing point for merchandise. It has the general shops of the Texas & Pacific and of the Marshall & East Texas Railways, a car-wheel and foundry company, an oil mill, a cotton compress, a basket factory, a brick and tile yard, and other industries. Hallsville, Waskom, Harleton, and Elysian Fields are thriving towns. Jonesville, Scottsville, Woodlawn, Blocker, Karnack, Leigh, and Tallys are shipping points. Longview, just across the line in Gregg County, is a market and shipping point for the southwestern part of the county.

Jefferson and Shreveport were the markets and shipping points for Harrison County products prior to the building of the Texas & Pacific Railway. Several landings along Cypress Bayou and Caddo Lake also served as shipping points. The Marshall & East Texas Railway was constructed to Harleton about 25 years ago and later extended to the western limits of the county. About two years ago it was extended southeast to Elysian Fields. At present, the county has over 131 miles of railroad. The Texas & Pacific system traverses the county practically from east to west and also north from Marshall to Little Cypress Creek. The Marshall & East Texas Railway extends

across the county in a general northwest to southeast direction. The Missouri, Kansas & Texas Railway crosses the eastern part of the county, and the Texas & Gulf Railway, Santa Fe system, cuts the southwestern corner of the county. These railroads furnish good transportation facilities for Harrison County products.

The county is fairly well provided with public roads, although many of them are in poor condition the year around and all of them are in bad condition during a rainy season. More attention to the public highways would do much to decrease the time and cost of hauling products to market.

CLIMATE.

Harrison County has a temperate climate, with short, mild winters, the most disagreeable features of which are the sudden cold waves, known as "northers," which may occur at any time between November 1 and April 1. These are marked by a sudden fall of temperature, a brisk north to northwest wind, and often by a fall of sleet or snow. However, they are of short duration, lasting sometimes only a few hours, and at most for two or three days. This feature accounts for the variation of the seasonal climate during consecutive years. This variation is especially noticeable in the winter months, and is due largely to the frequency and severity of these storms. During certain winters there are no cold waves of any consequence, while during others there are many. The snowfall, if any, is very light.

The summers are long and hot, the temperature frequently rising above 100° F., the heat being further accentuated by the humidity. The average length of the growing season is about eight months, more than ample for maturing crops and sufficient to allow two harvests of some crops.

The rainfall varies from 37.6 inches in the driest year on record to 60.9 inches in the wettest year. The average precipitation is 47.2 inches, which is quite well distributed throughout the year. The maximum rainfall occurs from November to June, and the minimum from July to October. Periods of rainy weather are sometimes experienced during the spring months and dry spells during the summer months. Both dry and wet weather damage crops, but the establishment of drainage systems, especially in the lowlands, will alleviate the latter and better methods of cultivation of crops will tend to remove the liability of damage by droughts.

The following table, compiled from the records kept at Longview, 24 miles west of Marshall, and at Marshall, give valuable data regarding the temperature and precipitation of the county. The records for Marshall cover only the last three years. These years have been marked by low precipitation.

Normal monthly, seasonal, and annual temperature and precipitation at Longview and Marshall.

Month.	Longview.						Marshall.			
	Temperature.			Precipitation.			Temperature.			Mean precipitation.
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Mean.	Absolute maximum.	Absolute minimum.	
	° F.	° F.	° F.	Inches.	Inches.	Inches.	° F.	° F.	° F.	Inches.
December.....	50	77	10	4.0	1.1	4.4	46	79	12	7.7
January.....	47	80	12	5.3	9.3	5.6	49	87	11	2.4
February.....	49	83	- 7	3.5	3.6	12.8	50	83	9	2.8
Winter.....	49			12.8	14.0	22.8	48			12.9
March.....	57	89	26	4.5	0.5	4.7	62	90	31	4.5
April.....	67	93	34	4.3	3.6	8.0	63	88	32	6.1
May.....	75	100	41	4.5	3.8	5.4	72	98	42	2.8
Spring.....	66			13.3	7.9	18.1	66			13.4
June.....	81	105	50	5.0	5.9	3.0	81	104	54	1.5
July.....	84	108	57	3.4	2.2	2.4	81	102	59	3.3
August.....	83	108	56	2.0	1.1	0.4	82	111	57	3.1
Summer.....	83			10.4	9.2	5.8	81			7.9
September.....	77	105	41	3.3	3.2	3.9	78	103	38	.8
October.....	67	96	32	3.0	0.6	6.5	68	97	23	2.4
November.....	56	93	21	4.4	2.7	3.8	53	87	15	1.9
Fall.....	67			10.7	6.5	14.2	66			5.1
Year.....	66	108	-7	47.2	37.6	60.9	65	111	9	39.3

AGRICULTURE.

Agriculture has been the leading industry of the county since the days of the early settlers. Cotton has always been the money crop, with corn next in importance and furnishing the greater part of the food of the people and the stock. Fields were planted continuously until yields declined and became unprofitable, when the lands were "turned out" and allowed to stand idle for a number of years. Ridge culture was the general practice and one-mule teams the rule, the incidental cultivating being done largely by hand. The cultivated fields were fenced and the stock allowed to graze free on the unfenced land. The cotton was hauled either to Jefferson or Shreveport or to landings along Caddo Lake and Cypress Bayou. The railroad stimulated farming by opening up new markets, but had no effect on the character of the crops or on the methods of farming. The early methods still prevail in their essentials with the majority of the farmers and cotton and corn continue to be the chief crops.

Many of the more progressive farmers in the county are abandoning the one-crop system practiced to this time in favor of a diversification of crops. This decision has been hastened by the advent of the boll weevil, the increased cost of crop production as a result of the higher cost of labor and rentals, and added expense for fertilizer as a means of maintaining crop yields. Cotton will doubtless continue to be the money crop, but many of the farm supplies now purchased with its proceeds will be grown on the farm and in many cases a reduction in the acreage devoted to cotton will enable the farmer to grow less important cash crops which, in turn, will tide him over periods of temporary financial depression and enable him to hold his cotton for a favorable market. Such a system will also allow the proper rotation of crops, thus maintaining the productivity of the soil through the constant replenishment of the organic content and the keeping of the soil in better physical condition.

About one-half of the cultivated land of the county is devoted to the production of cotton. Nearly two-thirds of the remainder is planted to corn. A variety of crops, including peanuts, sugar cane, sweet potatoes, Irish potatoes, and sorghum, are grown on the remaining cultivated area.

Triumph and King are the chief varieties of cotton grown. Preparations for planting usually start early in March. The land is plowed to a depth of 3 to 5 inches and "bedded up." Shortly before planting these ridges are leveled off and the seed planted thickly late in April or early May by means of one-horse cotton planters. The rows are "barred off" with a small turning plow shortly after the plants are up and "chopped," so that the plants are from 10 to 12 inches apart on the uplands and from 15 to 24 inches in the bottoms. The rows are placed from 3 to 4 feet apart on the uplands and from 4 to 5 and even 6 feet apart on the bottom lands. The cotton is given several cultivations and laid by about the middle of July. Picking begins in August and lasts throughout the fall. The cotton is ginned as fast as picked. The usual charge is about 40 cents per hundred pounds, the owner receiving the seed. In 1910 there were 72,660 acres in cotton, with a total yield of 18,162 bales, an average yield of one-fourth bale per acre. Last year over 25,000 bales were produced on a slightly larger acreage.

For corn the preparation of the land and its after cultivation are similar to that for cotton. The seed is planted in rows from 3 to 4 feet apart, leaving 18 to 24 inches between the hills. The seed is usually dropped by hand and covered either by turning a furrow over it or by pulling some soil over it with the foot. The crop is given clean cultivation until it is "laid by." Cowpeas are sometimes sowed between the rows at the time of the last cultivation. The corn is pulled and stored unhusked. Several varieties are grown

and very little attention is given to the selection of seed. The corn is consumed within the county and in addition a very large amount is shipped in for feed. Yields vary with the seasons and the fertility of the soil, ranging from 8 to 35 bushels per acre. On small areas as high as 60 bushels per acre are reported. In 1910 the output from 51,578 acres amounted to 564,159 bushels, or about 11 bushels per acre.

The acreage in peanuts is rapidly increasing, the census for 1910 showing nearly 2,400 acres. This crop is usually planted on the poorer portions of the farms. The peanuts are fed to hogs and the vines are used for hay. They should be grown more extensively both for feed and forage and to supply nitrogen in the soil.

Sugar cane is grown in small patches on the bottom soils. Although the acreage is comparatively small the total production of sirup from the cane is a matter of some importance. Sugar cane grown on the sandy bottoms produces the best grade of sirup. A two or three year rotation, consisting of sugar cane and either cowpeas or soy beans, should be practiced. Yields average about 200 gallons of sirup per acre, though as high as 475 gallons per acre have been reported. The sirup finds a ready market at 50 cents a gallon. The acreage of sorghum for sirup is decreasing. It is grown chiefly for forage.

The growing of Irish or sweet potatoes has never assumed commercial importance in this county. Both give good yields and should be grown as money crops. Irish potatoes should be an important crop with farmers who are trying to diversify their crops and may well be given place in orderly rotations. Two crops of Irish potatoes may be grown in the same season.

Winter oats are grown to a small extent as a cover and forage crop. They may be pastured lightly during the winter if the land is not too wet, and the crop cut for hay early in the summer. The land may then be plowed and sowed to cowpeas, which, though they may not mature a seed crop, will furnish a hay crop and at the same time improve the soil. The oats are seldom allowed to ripen. Winter rye may be used in the same way.

Watermelons are grown for home use and to supply the local market. At present very few are shipped to outside points. The melons are of good quality and should become one of the important money crops of the county on the sandy loams.

A few small truck farms are located in the vicinity of Marshall, and crops of this kind seem to do well on the lighter textured soils. Strawberries ripen at a season when they command a good price, and could be grown on a commercial scale. More attention should be given to the development of the trucking industry.

Bermuda grass is grown for hay and pasturage. This grass is unequalled for pasture, and yields 1 ton per acre when cut for hay. If the seed is sown in the fall or early spring a hay crop may be cut the following summer. Another method of starting this crop is to scatter fragments of Bermuda grass roots from an old field and to harrow them in. The former method is the quicker way to get a thick stand. The grass is cut once and sometimes twice during the summer. It also furnishes pasturage during the late fall and winter months. Very little Johnson grass is found in the county. White clover grows in spots, but no efforts have been made to use it in securing a sod. Bur clover makes a good growth, and should be sowed more extensively. Attempts to grow alfalfa have not, as a rule, been successful. One small patch observed near Scottsville is doing well. More attention should be given to this valuable crop. Well-drained first or second bottoms, preferably the latter, as they are not subject to overflow, should be selected. The upland soils should be well supplied with humus and treated with lime before the planting of this crop. Crab grass often kills out the alfalfa. Inoculation of the soil is necessary. Alfalfa is usually sowed in the fall without a nurse crop.

More attention should be given to the growing of grasses for hay and pasturage, as too much money is being spent for forage imported from outside points.

There are no pecan orchards in bearing in the county, although a number of orchards have been set out in the last three or four years. As a rule these have not received careful attention, and the dry summers of the past two years have killed a rather large proportion of the newly planted trees. Scattered pecan trees in bearing indicate that the nut does well in this climate and on these soils. Pecan growing should receive attention both for home use and on a commercial scale. Good results have been obtained by top working young native hickory with pecan. There are many young hickories in the forest, and this practice should be followed more extensively. Care should be taken to select the varieties for budding and planting best adapted to this section.

Figs are grown quite extensively for home use, and could easily be made a source of income. Mayhaw berries grow abundantly, and the jelly made from them would find a ready market. Fruits and vegetables are canned for home use. A good profit could be made by canning the surplus crop for local markets.

Several large peach orchards have been set out in the last eight years. The largest is located near Scottsville. Other large orchards are found near Chatterton and Orchard Park, on the Missouri, Kansas & Texas Railway. The Elberta is the chief variety grown. A

fine grade of peach is produced and good yields are secured in favorable seasons. The peaches ripen in June and are among the first on the Chicago market. While the profits from these orchards have not been what was anticipated, the prospects are not discouraging. The chief difficulty seems to be that the trees often bloom during a warm spell of weather in February, and the fruit is killed by subsequent frosts. The practice of smudging would doubtless save the crop, as the cold spells are of short duration and not very severe at that season. The orchards are given clean cultivation, except in seasons of no crop, when cotton is planted between the rows of trees. The trees are sprayed with lime-sulphur during the late winter or early spring.

There are a number of sawmills in the county, but the lumber output is small in comparison with that of a few years ago. The largest mill is located at Blocker, but it receives a large proportion of its timber from Panola County. Considerable hardwood forest growth is found in the bottoms, but the merchantable trees of the uplands are becoming scarce.

The cattle of the county are chiefly Jerseys and grades of that breed. The dairying industry has never received attention, except to supply local markets with milk and butter. As native grasses furnish pasturage during the greater part of the year and as forage crops can be easily and cheaply grown, milk can be produced very cheaply. More attention to this branch of farming would enable the farmer to grow a greater diversity of crops and to return a large amount of plant food to the soil in the form of stable manure. Attention should also be given to the improvement of the dairy herds, and hog raising should be practiced on a larger scale.

The boll weevil made its appearance in the county several years ago. The farmers are combating it by planting earlier varieties of cotton and by adopting cleaner methods of cultivation. The boll weevil, to a large extent, is responsible for the awakening of the farmers to the adoption of better agricultural methods and of the diversifying of crops.

The use of commercial fertilizers has increased rapidly within the last 10 years. In 1910 over 300 farms reported an expenditure of \$9,393 for fertilizers. A large proportion of this expense could be saved by practicing scientific methods of farm management. The present supply of stable manure is inadequate, but it all should be carefully saved and applied to the fields.

A large part of the cultivated land of the county is farmed under the tenant system. The land is rented outright for \$3 to \$5 an acre or for one-fourth of the cotton and one-third of the corn, the renter to furnish everything necessary to cultivate the land. Some tracts

are rented for 1 bale of cotton per 25 acres. In this case the owner of the land furnishes seed, tools, stock, and house, in fact everything except labor. The other crops are divided equally. Under this system the land owner frequently extends to the tenant credit for necessaries or advances him money at a certain rate of interest secured by the cotton to be grown on the land.

In the eastern and southern sections of the county the laborers are nearly all colored. In the western and northwestern parts the laborers are mainly white and a few colored. Laborers are usually hired for the season, wages ranging from \$10 to \$15 per month with board. Day hands receive from 50 to 85 cents, although during busy seasons wages often run as high as \$1 per day.

According to the census of 1910, out of a total of 558,080 acres in the county there are 438,557 in farms. Of this number 258,561 acres, or 59 per cent, are improved. The average size farm is 95.3 acres, of which 56.2 acres are improved. The small size of the farms is due to the classification of each tenancy as a farm. The individual holdings are considerably larger. There are very large tracts in the eastern part of the county which are owned by one man or by an estate. Some of these tracts have very little improved land and others are divided into a number of small tenancies. In 1910 there were 2,212 farms operated by the owners.

The value of farm lands of the county seems to be little influenced by location or by soil type. Land within a short radius of Marshall is slightly higher in value than in the more distant parts of the county, ranging from \$5 to \$25 per acre, the latter figure being for improved farms near a market. From \$10 to \$12 per acre is probably the average price of farm land in the county. Some of the bottom land is valued chiefly for its forest growth. There has been a noticeable increase in land values in the last few years, but prices are still lower than the character of the soils would justify, largely on account of the backward stage of agriculture.

Many suggestions can be made for the improvement of the agriculture of the county. In regard to the tillage of the soil, there should be deeper and better plowing to enable the soil to absorb and to retain a larger amount of moisture for the growth of crops and to assist in the prevention of erosion. This should be done by gradually increasing the depth of plowing about an inch each time the land is broken, until the depth is from 6 to 10 inches. The rows should follow the contour of the slopes and the steep slopes should be terraced to increase the amount of surface water absorbed by the soil, thus decreasing the run-off and to a large extent preventing erosion. Crops should be given level cultivation, especially upon the uplands, to aid in the retention of moisture. After the crop

roots have grown out into the middle of the rows the cultivation should be shallow to prevent the cutting off of the feeding roots, which decreases the resistance of the plant to drought. Frequent cultivation should be practiced to minimize the loss of moisture by evaporation.

To accomplish these ends the adoption of improved machinery is necessary. A few of the more progressive farmers are using modern farm machinery, and their example is being followed, but not as rapidly as the results warrant. Stumps and trees should be removed from the fields in order to facilitate the use of such implements as the two-horse plow, harrow, two-horse cultivator, weeder, etc., which can be used to advantage on the greater part of the uplands and on all of the bottom lands of the county. The use of modern farm implements would result in a saving of time and labor, thereby reducing the cost of production and increasing the crop-producing power of the soil. They would enable the farmer to cultivate a larger acreage or to cultivate the same acreage much better than with the old implements. Better care should be taken of farm tools and machinery.

Open and tile drainage on the poorly drained areas would insure earlier planting and better crops at a comparatively small cost for the installation. The loss or damage of crops by overflow during periods of excessive rainfall could be largely prevented by straightening the stream channels. These streams now follow a very meandering course and the drainage is slow. When straightened the fall would be sufficient to cause them to deepen their channels and to keep them open. This, together with the construction of a few laterals, would furnish adequate drainage of the bottom lands. The sandy bottoms have quite a perceptible slope and could be terraced to accomplish similar results. The bottom soils are very productive and should be developed at once.

The aim of the rotation of crops should be to grow a sufficient quantity of corn, hay, and forage for feeding the stock, to produce many of the supplies for family use, which are now purchased with money from the cotton crop, to make cotton the surplus crop, and at the same time to increase the productiveness of the soil. The rotation should include a legume such as cowpeas, soy beans, bur clover, or vetch, both for green manure and for the nitrogen gathered from the air by this group of plants. Under such a system more stock could be kept and large amounts of plant food could be returned to the soil in the form of barnyard manure. The exact character of the rotation should be determined by the needs of the soil and the choice of the farmer. An excellent rotation would be as follows, cotton followed by corn with cowpeas after the last cultivation of the corn and then winter oats followed

by cowpeas. This would give at least four harvest crops and some pasturage in a period of three years. This rotation may be varied to suit the individual taste of the farmer by planting other crops, such as potatoes, peanuts, melons, etc.

The credit system, under which the farmer gives a lien on the coming crop in return for supplies and money, is an obstacle to his prosperity. By diversifying his crops he will be able to farm on a cash basis and to become independent of the credit merchant and the money lender.

SOILS.

Harrison County occupies a portion of the Gulf Coastal Plain, which is made up of unconsolidated sands and clays. These deposits have been derived mainly from the older land formations far to the north and northwest. They were deposited in water and subsequently exposed by an uplift of the floor of the sea, which covered this county during the deposition of these sediments. According to the United States Geological Survey, the deposits in this county are known as the Sabine formation of the Eocene age.

Based upon their method of formation, and distinguished by topography as well, the soils of the area may be divided into two divisions: (1) the upland or sedimentary soils, and (2) the lowland or alluvial soils. The soils of the sedimentary division have been derived from the weathering of the above-mentioned formation. The agencies of weathering have brought about great changes in these sediments and have given rise to, and, to a large extent, have determined the location of the soils of the Susquehanna, Orangeburg, Norfolk, Ruston, Caddo, and Lufkin series.

The soils of the alluvial or lowland division may be subdivided into groups based mainly upon the source of the material of which the soil is composed: (1) the reworked material from the uplands of the survey, which has given rise to the Sanders and Kalmia series, and (2) the reworked material from the Cretaceous prairies to the west, which has formed the Trinity series.

The characteristics of the series of the upland division are as follows: The Susquehanna series has gray surface soil, red to mottled red, yellow, and gray clay subsoil; the Orangeburg series, gray surface soil, red sandy clay subsoil; the Norfolk series, gray surface soil, yellow sandy clay subsoil; the Ruston series, gray surface soil, buff sandy clay to sandy clay loam subsoil; the Caddo series, gray to yellowish surface soil, mottled yellow, red, and gray clay loam subsoil; and the Lufkin series, gray surface soil, gray to brownish-gray clay subsoil.

The characteristics of the series of the alluvial division are as follows: The Sanders series has brown to nearly black surface soil, mottled brown, yellow, and gray subsoil; the Kalmia series, dark-gray to brown surface soil, mottled brown, yellow, and gray subsoil; and the Trinity series, black to dark-brown surface soil, mottled yellow and gray clay subsoil.

As there is a striking similarity in the surface soils of the uplands of the county, the color and texture of the subsoils and the drainage conditions are the factors which mainly determine the different series. The Orangeburg series owes its characteristic features, as distinguished from the Susquehanna series, to a more complete oxidation resulting from better drainage. This advanced oxidation accounts for the more uniform red color and the more friable structure of the subsoils of the former series. The higher content of sand in the subsoils of the Orangeburg soils, as compared with the subsoil of the Susquehanna series, may be the result of a partial working out of the clay particles subsequent to the establishment of better drainage and to the more complete oxidation of the subsoil material.

The lighter color of the subsoils of the Norfolk, Ruston, and Caddo series, as distinguished from the subsoil of the Orangeburg and Susquehanna series, may be the result of peculiar local drainage conditions or of originally different material. The position of these series, with respect to that of the Orangeburg and Susquehanna series, seems to indicate that they are derived from lighter colored strata of the same formation as that from which the latter series are derived. Local drainage conditions and oxidation have mainly determined the differences between the subsoils of the Norfolk, Ruston, and Caddo series.

The factors which determine the lowland series are the position and the sources of the reworked material.

In this county there occur from one to five soil types in each series. They are differentiated from each other by the relative proportion of the particles of different sizes contained in the surface soil and by the depths to the subsoil material. Hence the different types of a series are largely determined by the degree to which the finer earth particles have been worked out, through the agencies of erosion, subsequent to the weathering of the sand and clay strata. The partial disintegration of the ferruginous sandstone, which the cementing action of iron oxide formed from certain of the sandy strata of the formation, accounts for the presence of gravel over a large part of the uplands of the county.

The soils of the county have been correlated with soils mapped in other areas in the Gulf Coastal Plain.

The names of the several types, together with the actual and relative extent of each, are given in the following table:

Areas of different soils.

Soil.	Acre.	Per cent.	Soil.	Acre.	Per cent.
Susquehanna fine sandy loam.	265,728	47.6	Orangeburg fine sand.....	2,560	0.5
Caddo fine sandy loam.....	84,992	15.2	Norfolk fine sandy loam.....	2,560	.5
Ruston fine sandy loam.....	48,320	8.7	Orangeburg fine sandy loam..	1,920	.3
Sanders silt loam.....	39,680	7.1	Meadow.....	1,280	.2
Sanders fine sandy loam.....	31,680	5.7	Lufkin silt loam.....	1,152	.2
Susquehanna gravelly sandy loam.....	26,368	4.7	Susquehanna sandy loam.....	960	.2
Norfolk fine sand.....	13,824	2.5	Ruston fine sand.....	960	.2
Kalmia fine sand.....	13,120	2.3	Susquehanna clay.....	832	.1
Trinity clay.....	7,488	1.3	Orangeburg sandy loam.....	832	.1
Susquehanna fine sand.....	6,720	1.2	Orangeburg loamy sand.....	320	.1
Sanders clay.....	3,840	.7	Kalmia sand.....	64	.1
Kalmia fine sandy loam.....	2,880	.5	Total.....	558,080	.....

SUSQUEHANNA FINE SAND.

The surface soil of the Susquehanna fine sand consists of a loose, gray fine sand, from 24 to 30 inches deep, underlain by a stiff, red to mottled red, yellow and gray clay. The surface is almost white in fields which have been under cultivation for some time, and gray or dark gray in uncultivated areas. For a few inches immediately above the subsoil the soil often has a reddish cast. Angular gravel is usually present on the surface and in the soil.

Northeast of Hallsville, between Tyler and Gilmer Roads, occurs a rather broken section of country, within which are areas having a sandy mantle from 1 to 6 feet in depth. In these areas the Susquehanna fine sand seems to be the predominating type, although small areas of Norfolk fine sand and Susquehanna gravelly sandy loam occur indiscriminately on the crests and slopes of the hills and ridges. It was found impossible to separate these on account of their small size and they have been included with the Susquehanna fine sand. These areas are always underlain by the typical subsoil of the Susquehanna series and contain a fairly high percentage of small sandstone fragments in the soil and on the surface. Several small areas of the type occur in other parts of the county. The topography ranges from gently rolling to rather broken. Drainage is usually excessive, especially over the areas of broken topography.

The Susquehanna fine sand represents areas of weathered Gulf Coastal Plain deposits of Eocene age, where the agencies which remove the finer material have been very active and where the removal of the finer particles is more advanced than in the case of the Susquehanna fine sandy loam.

The forest growth consists chiefly of oak, hickory, and pine. Scrub oak is especially abundant on the deep, sandy areas of the type. Native grasses make a good growth. Small shrubs are numerous.

The rolling portions of the type are planted to cotton and corn. It is considered an early soil and gives fair yields in favorable seasons. Like the other upland soils of the county, attention should be given to the restoration of the supply of organic matter which has been depleted or lessened by careless methods of farming. The growing of winter cover crops and the practice of some rotation should be encouraged. A system of reforestation should be adopted on the steeper slopes and the hilly areas of the type. The native grasses afford pasturage during a large part of the year.

SUSQUEHANNA SANDY LOAM.

The surface soil of the Susquehanna sandy loam consists of a loose, friable gray to grayish-brown, light sandy loam from 12 to 15 inches deep. Typically the color grades downward from the gray surface material to a brown or grayish-brown material into that having a brownish-red color just before the subsoil is reached. The texture varies from a medium to a coarse sand to a sandy loam over different areas of the type. A few small sandstone gravel occur on the surface and in the upper portion of the soil profile.

An abrupt change in the color and texture marks the line between the soil and subsoil of the type. The latter is a stiff red clay usually mottled red, yellow, and gray below a depth of 24 inches. The intensity of the mottling increases with depth. Small quantities of coarse and medium sand render the subsoil less plastic and more brittle than that of the Susquehanna fine sandy loam. This sand content is noticeably higher near a depth of 3 feet. With slight local variations in color and texture the mottled subsoil extends to a depth of several feet.

The type occupies gently rolling hills and ridges east of Harrison and north of Quapaw Bayou, in the eastern part of the county. Another area is located about 2 miles west of Elysian Fields and a small one nearly 2 miles southeast of Hallsville. The position and topography of the type insure good surface drainage and the structure of the subsoil allows adequate underdrainage.

The Susquehanna sandy loam owes its origin to the weathering of the sandy clay beds of the Eocene and to the subsequent removal of the finer particles, fine sand, silt, and clay, by drainage water.

Practically all of the type has been or is at present under cultivation. Some old fields have been "turned out" and now support a growth of pine, sassafras, and native grasses. These fields were parts of large estates prior to the Civil War and were not abandoned

on account of the natural unproductiveness of the type, but in accordance with the old practice of allowing the fields to "rest" after a number of years of cultivation. Cotton and corn produce moderate yields. Practically no other crops are grown on the type. Peanuts should prove profitable.

Erosion could be reduced to a minimum by the contour method of planting, or by terracing, if the slopes are steep. A rotation of crops, including some legume, should be practiced, as the soil is deficient in organic matter. Winter cover crops would prove beneficial both to prevent erosion and as a green manure.

SUSQUEHANNA FINE SANDY LOAM.

The soil of the Susquehanna fine sandy loam consists of a gray, fine sand to a light fine sandy loam, from 8 to 18 inches deep, with an average depth of about 14 inches. The subsoil is a stiff clay of a red or red mottled with yellow and gray color extending to a depth of several feet.¹ The color of the soil is prevailingly gray, but for a few inches above the subsoil it has a reddish cast, which gives freshly plowed fields a spotted appearance in shallow portions of the type. Frequently the surface has considerable gravel, especially on the ridges and the steep slopes. This gravel, which consists of small fragments of ferruginous sandstone and iron concretions, decreases in quantity with depth and seldom occurs in the subsoil. A limited quantity of quartz gravel is found along the Camden-Shreveport road southeast of Hallsville. The more gravelly areas are indicated by gravel symbols on the soil map. Areas of Susquehanna gravelly sandy loam, too small to show on the map, occur throughout the type. The boundaries between the soil and subsoil are usually sharply defined.

The Susquehanna fine sandy loam may be said to have two more or less distinct phases, resulting chiefly from conditions of oxidation and drainage. First, that part occupying the more rolling and hilly sections of the country, which has a fairly high gravel content and a dominantly red subsoil with a few yellow and gray mottlings below a depth of 24 to 30 inches. The last few inches of the subsoil containing yellow sandy concretions has a crumbly brittle structure. Second, that part occupying undulating to nearly level sections of the country, which consists of a dark-gray to grayish-brown fine sandy loam, underlain by a sticky, yellowish clay loam, which rests upon a mottled red and gray plastic clay. This phase contains practically no gravel and is found in the southeastern part of the county and in the vicinity of Caddo Lake. It closely resembles the Caddo fine sandy loam above a depth of 20 inches. Below that depth the

¹ The subsoil of this type does not seem to be quite so heavy and plastic as that of the type as mapped in other regions.

subsoil is too heavy and too plastic to be classed with the Caddo series. The soil of this phase is more compact than that of the remainder of the type. The typical Susquehanna fine sandy loam of this survey is intermediate between the two phases, and comprises the larger proportion of the type.

The soil is usually deeper on the tops of the ridges than on the slopes. The depth in certain localities is uniformly less than over the greater part of the type. Such a condition exists about 4 miles southeast of Jonesville and also a short distance south of Hallsville. The soil is loose and porous and easily cultivated.

The Susquehanna and Orangeburg fine sandy loams closely resemble each other in color and texture of soil, but differ in this respect in the subsoil. In the former the subsoil is a stiff, mottled red, yellow, and gray clay; in the latter, a red friable sandy clay.

This type is the most extensive and important soil of the county and is widely distributed over the upland.

The topography has been largely developed by erosion and varies from gently rolling to hilly, the greater part being rolling. The type occupies the stream valleys and many of the ridges and divides with numerous V-shaped draws on many of the slopes. The more level portions of the type occur in the vicinity of Caddo Lake and in the southeastern corner of the county. On account of the prevailing rolling topography natural surface drainage is usually sufficient, but the impervious character of the underlying subsoil frequently causes the less rolling areas to drain very slowly.

The chief difficulty in the cultivation of the type arises from its tendency to erode excessively on the slopes. (See Pl. X, fig. 1.) After the surface soil has become saturated with water during a rain, because the stiff, impervious subsoil prevents the rapid downward movement of water, the drainage water flows down the slope, carrying with it large quantities of soil and subsoil material. This has resulted in the exposure of the underlying clay subsoil in numerous gullies and over small areas on the slopes.

The Susquehanna fine sandy loam is derived from the weathering of the Sabine formation of Eocene age, modified by the combined agencies of erosion, washing, oxidation, and drainage.

The native vegetation consists of pine, oak, hickory, gum, and other hardwoods. Native grasses are abundant where the forest is not dense.

The type is devoted principally to the production of cotton and corn. Practically no system of crop rotation is followed and the fields are cropped to cotton and corn for many years in succession. Yields are largest on newly cleared land and decrease with the diminution of the organic matter. Cotton yields from one-fourth to one-half of a bale per acre. Yields of corn vary from 8 to 25 bushels

per acre. Winter oats are grown to a limited extent as a forage crop. The acreage devoted to peanuts has increased during the last few years. This crop does well and should be grown more extensively as a forage and money crop and on account of its beneficial effects upon the soil. Irish potatoes, sweet potatoes, and watermelons are grown chiefly for home consumption. These crops do well and should be planted more extensively in order to develop the more profitable system of diversified farming. Peaches of excellent quality are produced in favorable seasons. Good profits are secured from several small truck farms on the type. The crops mature early and find a ready market in Marshall.

The use of fertilizers has increased since the appearance of the boll weevil. Large quantities of cottonseed meal are used at planting time.

There are two important matters to be considered in handling the Susquehanna fine sandy loam; first, the prevention, or the reduction to a minimum, of soil erosion, which annually destroys many acres of the type; second, an increase in the organic-matter content of the surface soil. The steeper slopes should not be cultivated if already cleared, but should be reforested, and if uncleared, some system should be adopted which would promote the growth and development of the trees for merchantable timber. The contour method, and in some cases the terrace method of farming, should be practiced on the slopes of the type. The growing of cover crops, such as winter oats or rye, would prevent the rapid movement of surface water and aid in binding the loose soil, and thus check erosion during the winter months. Deeper plowing would enable the absorption of more rainfall and diminish the run-off.

As the supply of stable manure is not adequate, it becomes necessary to resort to the use of green manuring crops in order to increase the store of organic matter in the soil. The turning under of the roots and stubble of the winter cover crops would add considerable organic matter. Cowpeas may be sown either between the rows of cotton or corn after the last cultivation and turned under the following spring, or may be used as one crop or in the rotation, in which case they are sown in the spring and cut for a crop of cowpea hay or for seed. The land may then be plowed for winter oats. When sowed with the corn, the peas often ripen and produce a good seed crop.

Applications of slaked or unslaked lime or of ground limestone would be beneficial to the greater part of the type, especially in connection with the use of green-manure crops. The use of lime would hasten the decomposition of the organic matter, improve the physical condition of the soil, and increase its general productiveness.

During the summer months crops on the Susquehanna fine sandy loam are apt to suffer from insufficient moisture. The incorporation



FIG. 1.—EROSION ON SUSQUEHANNA FINE SANDY LOAM.



FIG. 2.—TYPICAL CADDO FINE SANDY LOAM.

of organic matter in the soil would increase its moisture-holding capacity, while frequent and shallow level cultivation would decrease the loss by evaporation and conserve the soil moisture for growing crops.

Tile drainage would enable earlier planting in wet seasons and improve the physical condition of the type.

Rotation of crops should be practiced and a system devised adapted to the needs of the individual farmer. It should include some leguminous crop, such as cowpeas or soy beans.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Susquehanna fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
443101.....	Soil.....	0.3	0.2	0.3	4.1	52.0	39.0	4.3
443102.....	Subsoil.....	.0	.0	.2	.5	16.6	16.7	66.1

SUSQUEHANNA GRAVELLY SANDY LOAM.

The soil of the Susquehanna gravelly sandy loam is a gray to reddish-gray gravelly fine sand to gravelly fine sandy loam 10 to 20 inches deep. The subsoil is a red clay, which usually becomes mottled with yellow and gray in the lower depths. The characteristic of the type that distinguishes it from the Susquehanna fine sandy loam is the high gravel content of the soil and often of the subsoil. This gravel consists of fragments of ferruginous sandstone, of iron crusts, and of iron concretions, ranging in size from that of a pea to one-half inch in diameter. It is seldom present in sufficient quantities to interfere with cultivation. Large fragments and outcrops of sandstone are present in limited portions of the type. Such areas are indicated on the map by means of outcrop and loose rock symbols. A few small areas of rough stony land are included within this type.

Practically all of the type occurs in the northern half of the county, the largest area being found north of Little Cypress Creek.

The Susquehanna gravelly sandy loam usually occupies the highest elevations in the section of the county where it occurs and on steep slopes facing the stream bottoms. The hills and ridges are often very prominent, the highest being locally known as mountains. The surface features range from rolling to hilly and broken. The slopes toward adjacent soils are often steep and traversed by numerous V-shaped draws. The structure and position of the type always insures sufficient and often excessive drainage.

This soil is derived from the weathering of the Sabine formation of Eocene age. The gravel is chiefly due to the partial disintegra-

tion of ferruginous sandstone, formed by the cementing action of iron oxide on the sandy strata of the same formation. Quartz gravel is not common, though a considerable quantity occurs along the Camden-Shreveport road about 5 miles southeast of Hallsville.

The native forest growth consists mainly of pine, hickory, and oak, especially black-jack oak. Much of the rolling portion of the type has been cleared and is farmed to corn and cotton. Cotton yields from one-fifth to one-third bale and corn from 10 to 20 bushels per acre. Small patches of peanuts, oats, and potatoes are grown for home use. This type is considered an early soil, probably the earliest in the county. It is subject to drought during protracted dry spells, and crops often suffer during the latter part of the growing season. The Susquehanna gravelly sandy loam is deficient in organic matter and is subject to erosion. The methods outlined under the description of the fine sandy loam of this series should be followed in order to remedy these conditions.

A considerable proportion of the type is too rough for cultivation. At present there is a large amount of practically waste land within the type. Nearly all of the forested areas have been logged off and no attention has been given to reforestation. Forest on this soil would bring a good income within a comparatively few years from areas now furnishing only firewood and scanty pasturage.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Susquehanna gravelly sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
443107.....	Soil.....	2.2	1.5	3.0	63.3	14.2	11.4	4.7
443108.....	Subsoil.....	.2	.5	1.1	43.1	8.1	7.7	39.5

SUSQUEHANNA CLAY.

The surface soil of the Susquehanna clay, where not entirely removed by erosion, consists of a gray fine sandy loam from 2 to 4 inches deep. The subsoil is a stiff, tenacious red clay, showing mottlings of red and gray at a depth of 12 to 15 inches, extending to a depth of 3 feet or more. The number and size of the gray mottlings increase with depth. The type is refractory and difficult to till. It differs from the Susquehanna fine sandy loam only in that the sandy mantle is either thinner or entirely lacking.

Two small nearly level areas are found just west of Goose Prairie Lake, an arm of Caddo Lake. The soil here consists of 4 to 5 inches of a gray very fine sandy loam, underlain by a mottled red and gray

clay subsoil, which has a much higher percentage of gray than the subsoil of the higher lying areas of the type.

The largest area of the type occupies a steep gullied slope along the lower course of Cypress Bayou and extends for short distances east and west from the old Port Caddo landing. Numerous similar small areas, the majority of them too small to map, occur along draws and as clay knobs in the rolling portions of the Susquehanna fine sandy loam. These have resulted from the removal by erosion of a large part of the soil material of the above-mentioned type.

The steep slopes and the impervious character of the subsoil cause the surface water to run off quickly and to make erosion an active source of damage to the type.

The Susquehanna clay is the result of the weathering and incomplete oxidation of the Eocene sediments. On the slopes the surface drainage carries away both fine and coarse material and does not permit the accumulation of the coarse material to any depth.

Portions of the type support a growth of pine, hickory, and oak. Only small areas, occurring within fields of Susquehanna fine sandy loam, are under cultivation, the type being unimportant in the county. In handling this soil the problem is not one of managing the refractory clay, but rather how to check the excessive erosion. When first plowed the type is quite unproductive, but more advanced weathering, aeration, and the incorporation of organic matter would increase the yields.

RUSTON FINE SAND.

The Ruston fine sand consists of a light-gray fine sand from 15 to 20 inches deep, underlain by a reddish-yellow fine sand to loamy fine sand, becoming heavier with depth and grading into a sticky reddish-yellow to yellowish-red or buff heavy fine sandy clay at a depth of 30 to 36 inches. Frequently the soil is faintly mottled gray and buff. The structure is loose and open and the type well drained and easily cultivated. Small quantities of gravel are sometimes present.

The type is not extensive and occupies rolling hills and ridges within the Susquehanna, Ruston, and Caddo fine sandy loams.

In topography and position the type is similar to the Norfolk and Orangeburg fine sands, but the presence of the buff subsoil throws it into the Ruston series. In origin it is similar to the Ruston fine sandy loam, except that the process of washing, which results in the removal of the silt and clay particles, is more complete than in the latter type.

A part of the type is cultivated to cotton and corn, which give rather small yields under the present methods. The organic-matter

content is low and the type droughty. The use of green manuring crops to follow cotton or corn or as separate annual steps in a rotation of crops is strongly recommended.

RUSTON FINE SANDY LOAM.

The soil of the Ruston fine sandy loam consists of a gray to grayish-yellow fine sand to light-textured fine sandy loam, from 6 to 12 inches deep, underlain by a dingy yellow to buff fine sandy loam extending to a depth of 12 to 24 inches. The subsoil is a reddish-yellow, yellowish-red or buff heavy fine sandy clay to clay loam to a depth of 3 feet or more. Dull red mottlings sometimes appear at a depth of 30 inches, especially where the soil is from 10 to 12 inches deep. The change from soil to subsoil is gradual. Gravel sometimes occurs on the surface and in the upper portions of the soil. The upper section of the soil is loose and porous and the lower section is slightly sticky. The structure of the subsoil ranges from slightly friable to somewhat plastic. Cultivation is easy under a wide range of moisture conditions.

The type has a wide distribution throughout the county. Its most extensive development is found in a belt from 4 to 5 miles wide north of the bottom lands of the Sabine River. Isolated areas of varying size are found in nearly all parts of the county.

The topography is intermediate between that of the Susquehanna and the Caddo fine sandy loams, the type occupying gently rolling divides and narrow, low-lying approaches to stream bottoms. In general, the Caddo fine sandy loam occurs on divides in the eastern part of the county and the Ruston fine sandy loam on the divides in the western part. Drainage is usually good. The moisture-holding capacity is fairly high and if moisture is properly conserved by cultivation it is sufficient to meet the needs of growing crops in average seasons.

The subsoil of the Ruston fine sandy loam is not so yellow as that of the Norfolk fine sandy loam nor so red as that of the Orangeburg fine sandy loam. In texture it is not so friable as the subsoils of the Norfolk and Orangeburg series, but more so than those of the Susquehanna and Caddo soils.

It is probable that the Ruston fine sandy loam, like the Norfolk and Caddo soils, is derived from the weathering of the lighter-colored strata of the Sabine formation. The difference in color of the subsoils of the Ruston and Norfolk or Caddo fine sandy loam is probably due to better drainage conditions, which have resulted in a more complete oxidation of the materials. The higher sand content has probably resulted from a working out of the silt and clay, subsequent to the establishment of better drainage.

The uncleared areas support a growth of pine, oak, hickory, gum, and native grasses.

The farm methods and crops are the same as on the other upland soils of the county. Cotton yields from one-fourth to one-half bale and corn from 10 to 25 bushels per acre. This type is a general-purpose rather than a special-crop soil and should be improved for the production of general farm crops. It is regarded highly on account of its good drainage, moisture-holding capacity, ease of cultivation, and responds readily to good treatment.

Like the other upland soils of the county, the type is deficient in organic matter, a feature which should be remedied by the liberal use of stable and green manures. Winter cover crops, such as oats or rye, will check erosion and also aid in increasing the organic matter, while deep plowing, with frequent and shallow cultivation, will help to conserve the soil moisture. The fertilizer treatment is practically the same as on other upland soils.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Ruston fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
443103.....	Soil.....	0.2	0.6	1.7	34.7	24.9	29.1	8.6
443104.....	Subsoil.....	.0	.5	1.0	15.0	23.0	24.3	36.4

NORFOLK FINE SAND.

The Norfolk fine sand consists of a gray to white, loose fine quartz sand, with an average depth of 10 inches, underlain by a light-gray to yellowish-gray fine sand, extending to a depth of 3 feet or more. In its virgin state and when first put under cultivation the color of the soil is dark gray, but after a few crops have been grown the color changes to a light gray or white, through loss of the original content of organic matter. In fact, the organic-matter content in the soil is the only difference between the soil and subsoil of a large part of the type in this county. The yellowish cast of the subsoil is present only when the yellow sandy clay substratum lies at or near a depth of 3 feet. The sandy mantle varies in depth from 3 to 10 feet and in some cases probably more. The type is usually underlain by a yellow sandy clay, similar to the subsoil of the Norfolk fine sandy loam. Some deep areas are probably underlain by a substratum similar to the subsoils of the Susquehanna series. Small hills, narrow ridges, and the rougher portions of the type carry

small quantities of gravel. The soil is loose and incoherent and easily cultivated under a wide range of moisture conditions.

The Norfolk fine sand differs from the Orangeburg fine sand in having a gray fine sandy subsoil about 3 feet deep, while in the latter type it is a red fine sandy loam to sandy clay below a depth of 24 inches.

The largest and most important area of the type lying northeast of Harleton covers several square miles. Two areas, each about a square mile in extent, occur, one about 4 miles northeast and the other about 4 miles southeast of Woodlawn. Other small isolated areas are located in various parts of the county.

The Norfolk fine sand has two distinct topographies, the gently rolling to rolling portions of the type which occupy the higher elevations, with the fine sandy loam of either the Ruston, Norfolk, or Susquehanna series in the intervening valleys or depressions, and the ridged or hilly portions of the type which occupy a continuous area of uneven country. The texture and structure of the type and its position favor the rapid movement of soil water and furnish excellent natural drainage. Drainage is sometimes excessive over the deeper areas of the type, and unless crops are given the proper cultivation at the right time they suffer from drought even during short spells of dry weather.

In this county the Norfolk fine sand probably owes its origin to the accumulation of fine sand, caused by the removal by water of silt and clay from the weathered products of the sandier strata of the Sabine formation. That part of the type found northeast of Harleton may have its origin in later superficial deposits of sand, possibly of the Lafayette formation.

Varieties of pine and oak form the most of the forest. The deep, sandy areas support a scrubby growth of blackjack and blue oak. Native grasses flourish in season where the forests are sufficiently open.

The cultivated portion of the Norfolk fine sand is planted to cotton and corn. Yields range from one-fourth to one-half bale for cotton and from 8 to 20 bushels per acre for corn. Yields are usually low on account of the relatively small amount of organic matter in the soil and its insufficient moisture capacity to maintain a steady growth during all parts of the growing season.

Improved farming methods are necessary if the farmers are to secure better yields. The organic-matter content should be increased by the use of green manuring crops, sown either between the rows at the last cultivation of cotton or corn and to be plowed under the following spring or by using some legume as a separate step in a crop rotation. Lime should be used in connection with the use of green manures, in order to insure the prompt decomposition of the organic

matter. The use of stable manure is recommended whenever it is available.

As the soil is loose and incoherent, methods of cultivation which will pack the subsurface and keep the surface loose are recommended. Frequent and shallow cultivation should be practiced during the summer months. There is considerable loss of fertilizers by leaching where the soil is deep.

The type is probably best adapted to truck or to any short-season crop which matures before the dry spells set in. Truck farming is not practiced to any extent. Peaches should do well where the sand is not too deep.

NORFOLK FINE SANDY LOAM.

The surface soil of the Norfolk fine sandy loam consists of 5 to 6 inches of friable gray fine sand to fine sandy loam, resting upon a grayish-yellow fine sandy loam, from 12 to 18 inches deep, and underlain by a yellow sandy clay. This stratum extends to a depth of 3 to 5 feet and is succeeded by a mottled reddish-yellow and gray clay substratum. Faint mottlings of red sometimes occur below a depth of 30 inches. The change in color and texture from soil to subsoil is very gradual.

The type has a gray surface soil and a yellow subsoil differing in this respect from the Orangeburg fine sandy loam, which has a gray surface soil and a deep red subsoil, and from the Ruston fine sandy loam, which has a gray soil and a reddish-yellow or buff subsoil.

The type is not extensive although found throughout the county, isolated areas from 10 to 300 acres in extent occurring in all parts of the upland. The topography is gently sloping to nearly level. Surface drainage is slow and the movement of subsurface moisture retarded by the heavy substratum. By reason of its position the type receives considerable seepage water from surrounding soils. Although water does not stand on the surface nor in the soil for any length of time, the greater part of the type would be greatly benefited by a system of artificial drainage.

The Norfolk fine sandy loam is probably derived from the weathering of the Sabine formation of the Eocene age. Whether the type owes the characteristic color of the subsoil, which differs from that of the Susquehanna series, to an original difference in the material from which it is derived or to peculiar local drainage conditions, it is not possible to determine from a study of the soils of the survey.

The original growth of pine and hardwood has been removed from nearly all the type, and the land put in cultivation. Cotton yields from one-fourth to one-half bale and corn from 10 to 25 bushels per acre. Peanuts do well and the acreage should be increased. The type is regarded as a productive soil for the general farm crops. Its

small extent does not justify its use for special crops. Yields can be increased by careful and thorough methods of farming, similar to those recommended for the other upland soils of the county.

CADDO FINE SANDY LOAM.

The surface soil of the Caddo fine sandy loam is a gray to yellowish-gray fine sandy loam, from 12 to 24 inches deep. The subsoil is a moderately stiff, dingy yellow fine sandy clay to fine sandy clay loam extending to a depth of 18 to 30 inches, and underlain by a yellow clay loam or fine sandy clay loam, mottled with red and gray. The average depth of the soil is about 14 inches, the mottled section of the subsoil being encountered at approximately 24 inches. The type carries a higher percentage of very fine sand and silt than the other upland soils of the county. The mottled character of the lower portion of the subsoil is the result mainly of insufficient drainage, and the degree of mottling varies. In the wetter places the material is yellow, mottled with red and traces of gray; in the better drained areas the distribution of the colors is more even, or there is a predominance of the red. In the latter case the subsoil is quite friable.

A substratum of heavy, mottled clay usually underlies the type at a depth of slightly more than 3 feet. Dark-brown iron crusts and concretions occur in some of the flat areas and local developments of hardpan are found, but they are not typical. The surface soil is more compact, and it is not so easily cultivated under a wide range of moisture conditions as the other soils of the uplands.

A characteristic feature of the Caddo fine sandy loam is the presence of sand mounds from 2 to 5 feet in height and from 15 to 50 feet in diameter. They consist of gray to yellowish-gray fine sand to a depth of 30 to 36 inches, underlain by a mottled yellow, gray, and red clay loam to clay. Where the mounds are numerous the intervening areas are a brown, heavy fine sandy loam to a very fine sandy loam from 13 to 15 inches deep, underlain by a mottled yellow and gray clay loam to clay. In most cases these mounds have a circular base and a regular contour, and there is often a marked uniformity in their size within the same area. In some cases the soil of the intervening areas resembles the Lufkin fine sandy loam. In fields under cultivation only a short time the surface presents a spotted appearance, the mounds being gray and the intervening surface brown. In old fields, however, this difference is not as noticeable. The mounds are not confined to this type alone, but are sometimes found on adjacent portions of the Susquehanna fine sandy loam, especially in the southeastern part of the county.

The chief differences between the Norfolk and Caddo fine sandy loams are the slightly heavier texture and less friable structure of

the subsoil and the mottled appearance of the lower section of the subsoil of the former. The only resemblance between the Caddo and Susequehanna fine sandy loam is the mottled character of their lower subsoils. In the former type yellow is the predominating color, while in the latter it is red.

The type is extensively distributed in the eastern and southern parts of the county. Isolated areas of various sizes occur in the remainder of the uplands. The most extensive areas of the type are found in the vicinity of Caddo Lake, near Chatterton, and Orchard Park, on the Missouri, Kansas & Texas Railway, and near Elysian Fields.

The Caddo fine sandy loam occupies three distinct positions: First, on the undulating tops of comparatively broad divides; second, on gently sloping to level, low-lying approaches to streams; third, in slightly depressed areas around stream heads. The topography of this type is less varied than of any of the other upland types of the county except the Lufkin silt loam. (See Pl. X, fig. 2.) The streams, as a rule, have narrow and shallow valleys as compared with the V-shaped draws and deep, wide valleys of the other upland types.

The Caddo fine sandy loam drains slowly on account of its topography and position and the rather impervious character of its subsoil and substratum. The lower lying areas receive large quantities of surface and seepage waters from the adjacent types. In many cases water stands on the surface for some time after rain. This restricted drainage causes the type to be rather late in certain seasons. Crops suffer from insufficient drainage in seasons of average rainfall. Open ditches and tile drains would insure earlier planting of crops and increase the productivity of the type.

In origin the type is doubtless derived from similar material and sources as the Norfolk and Ruston fine sandy loams. The yellow color of the subsoil, as compared with the red subsoils of the Susquehanna and Orangeburg series, may be due either to peculiar local drainage conditions or to originally different material. It seems probable that the Caddo and Norfolk soils are derived from the weathering of lighter colored strata of the Sabine formation and that the difference in color of their subsoils is due to more or less advanced oxidation and aeration, resulting from the imperfect drainage of the former. The popular belief that the mounds were formed by escaping gas hardly seems to account for their presence in such numbers. They may have resulted from wind action under more arid climatic conditions.

The native vegetation is similar to that of the other upland types, and consists chiefly of pine, oak, gum, hickory, and other hardwoods.

A large part of the type is under cultivation. Cotton and corn are the principal crops, the former yielding from one-fourth to one-half

of a bale and the latter from 15 to 30 bushels to the acre. Other crops are grown to a very limited extent and only for home use. Two of the large peach orchards of the county are located on this type. These areas have been under cultivation for a long time and are among the better drained portions of the type. The trees give good yields of fruit of excellent quality in favorable seasons. Well-drained areas of the type are well adapted to this crop.

The Caddo fine sandy loam is not a special-purpose soil and should be used for the general farm crops. Open and tile drainage would improve the physical condition of the soil, promote oxidation, decrease the injury of crops by excess moisture, and allow the earlier planting of crops in wet seasons. Much of the type shows traces of acidity and would be improved by applications of lime. When first cleared it contains a fairly high percentage of humus, but the plowing under of green manure crops would increase its crop value. A rotation, including corn, cotton, and some legume such as cowpeas or soy beans, to add nitrogen and organic matter, should be adopted. Commercial fertilizers and cottonseed meal are used to some extent on the type.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Caddo fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
443135.....	Soil.....	0.0	1.5	2.8	25.7	33.0	33.2	4.0
443136.....	Subsoil.....	.0	.6	2.0	18.0	24.3	32.8	21.8

ORANGEBURG FINE SANDY LOAM.

The Orangeburg fine sandy loam consists of 6 to 8 inches of gray fine sand, resting upon a reddish-brown, fine sandy loam, becoming heavier with depth and grading into a friable, red fine sandy clay at about 15 to 20 inches. The texture of the soil varies from a fine sand to fine sandy loam in different areas of the type. The changes in color and texture throughout the soil section are very gradual. Small fragments of ferruginous sandstone and of iron concretions are often present on the surface and in the upper portion of the soil. The type is underlain at a depth of 3 to 6 feet by a heavy, mottled substratum similar to the subsoil of the Susquehanna series. The loose and porous nature of the soil admits air and water freely and the type may be worked soon after a rain.

A gravelly heavy phase of this type was mapped about a mile east of Woodlawn. This phase carries a higher percentage of gravel

than the typically developed areas. These sandstone gravels break up readily and impart to the subsoil a rather friable structure. The average depth of the soil is slightly greater than in the typical areas.

The extent of the type is small. The areas are small and scattered over the county. The greater part of the type is located in the northeast quarter of the county, where it occupies the gentle, lower slopes of hills of Susquehanna fine sandy loam, or gently rolling ridges surrounded by the latter type. The structure of the soil and subsoil and the position of the areas insure good surface and under-drainage.

The Orangeburg fine sandy loam is derived from the weathering of Coastal Plains sediments of Eocene age. It is distinguished from the Ruston and Norfolk fine sandy loams chiefly by the red color of its subsoil and from the Susquehanna fine sandy loam by the texture of its subsoil.

A large part of the type is under cultivation. It is regarded as one of the best soils of the survey on account of its good drainage, ease of cultivation, and productiveness. It is one of the best peach and truck soils in the county and also a good general farming soil. More attention should be given to truck farming on this type. Cotton and corn are now the chief crops, the former producing from one-third to one-half bale per acre and the latter from 15 to 25 bushels. The methods of farming which have been practiced on the type have depleted its supply of organic matter, and attention should be given first of all to the restoration of this constituent so necessary in a productive soil. This may be accomplished by following the methods prescribed for other upland types in the county. Deeper plowing should be practiced and the contour system of cultivation should be adopted for the slopes. Level cultivation will also be found helpful in controlling moisture supply.

The following table gives the results of mechanical analyses of samples of soil and subsoil of this type:

Mechanical analyses of Orangeburg fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
443111.....	Soil.....	0.1	0.5	1.4	34.2	31.5	26.8	5.3
443112.....	Subsoil.....	.0	.5	1.1	27.6	29.9	20.0	20.8

ORANGEBURG SANDY LOAM.

The soil of the Orangeburg sandy loam is a brown or grayish-brown medium sandy loam from 12 to 18 inches deep. Upon the

higher parts of the type the immediate surface is often a gray medium sand underlain by a brown loamy sand which in turn rests upon a brown sandy loam. The slopes are more loamy and darker in color. This soil material grades through a rather heavy red sandy loam to a red sandy clay, which extends to a depth of 3 feet or more and is usually succeeded by a stiff red clay similar to the subsoils of the Susquehanna series. The subsoil of the type as mapped in Harrison County is slightly heavier than that of the same type on the Atlantic Coastal Plain. Both soil and subsoil are practically free from gravel and rock fragments. The soil is porous and easily cultivated and the subsoil is moderately friable.

The largest and most typically developed area occurs just southwest of Leigh and is about a square mile in extent. Other smaller areas are found in the northeastern part of the county.

In position and topography this type is similar to the Susquehanna sandy loam in that it occupies broad, gently sloping tops of hills and ridges. A few V-shaped draws head within the type. It is well but not excessively drained, as its sandy clay subsoil is retentive of moisture.

This type represents the weathered product of the sandy clay deposits of Eocene age modified by the removal of much of the fine material by rain water during the weathering process. The type differs from the Susquehanna sandy loam in having a lighter textured and more friable subsoil.

A few old fields support a growth of young pines, sassafras, and grasses. Practically all of the remainder of the type is under cultivation to corn and cotton. The areas occupied by the Orangeburg sandy loam were among the first to be cleared and they are still producing good crops. The deficiency in organic matter may be remedied by the growing of green manuring crops. These may be planted either at the last cultivation of the two staple crops or made a step of a regular rotation. Lime should be used in conjunction with the green manures in order to promote the decomposition of the vegetable matter. The use of winter cover crops and contour farming would do much to check erosion. The steeper slopes should be kept in grass and used for pasture.

Deeper plowing would enable the soil to absorb and retain a larger amount of moisture. Frequent and shallow cultivation should be practiced in order to form a dust mulch and to decrease the loss of moisture by evaporation. The farmers should adopt definite rotation of crops, including some legume. Peaches of good color and

flavor are produced on the type and peach growing on a commercial scale would doubtless prove profitable.

ORANGEBURG FINE SAND.

The soil of the Orangeburg fine sand is a gray to reddish-gray fine sand from 20 to 30 inches deep with an average depth of about 24 inches. This is underlain by a few inches of red loamy fine sand, which grades into a heavy, red fine sandy loam, extending to a depth of 3 feet or more. The texture of the subsoil and the depth of the soil are subject to considerable variation. Gravel is often scattered over the surface and throughout the soil in large quantities. The soil is loose and easily worked under a wide range of moisture conditions.

The largest area of the type occupies the rolling country about 3 miles east of Woodlawn in the vicinity of the artificial lakes, Bonita, Highland, and Fern. It is traversed by a number of V-shaped draws and is one of the rougher portions of the county. Here the sandy material is thinnest on the tops of the hills and ridges, which are usually gravelly with a stiff red gravelly subsoil from 14 to 18 inches below the surface. The sand increases in depth down the slope until the subsoil is out of the reach of the soil auger. For a few feet on each side of the stream courses the soil resembles the Norfolk fine sand. Both the tops of the hills and the narrow strips along the stream courses are too small to show on the map. A large amount of gravel is present in this area. Other small areas of the type occur in many parts of the county, especially in the northeastern part of the survey.

The small areas have a gently rolling topography and are under cultivation as parts of larger fields, but only a small proportion of the large area is cleared, as it is too hilly and is excessively drained. Drainage on the other portions of the type is good.

The type bears the same relation to the Orangeburg fine sandy loam that the Norfolk fine sand does to the Norfolk fine sandy loam. It represents weathered material of the Sabine formation, subjected to more active washing with the removal of more of the silt and clay particles than is the case with the Orangeburg sandy loam.

The uncleared and rougher part of the type supports a growth of oak and a few pines.

The Orangeburg fine sand is a stronger soil than the Norfolk fine sand on account of the depth of soil and the structure of its subsoil. Average yields of corn and cotton are secured. The lack of organic matter should be supplied by the use of green manuring crops. The type is adapted to peaches and to early truck crops. The rougher

portions should be allowed to remain in forest or where cleared reforested, as this constitutes their most profitable utilization.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Orangeburg fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
443109.....	Soil.....	0.0	0.4	1.0	42.0	27.1	26.1	3.6
443110.....	Subsoil.....	.0	.2	.8	32.8	25.8	23.8	16.2

ORANGEBURG LOAMY SAND.

The Orangeburg loamy sand consists of a loose, gray to grayish-brown medium sand to a depth of 10 to 12 inches, changing gradually to a pale-red medium sand underlain at a depth of 24 to 30 inches by a reddish sandy loam to sandy clay. Small areas of the type show sand extending to a depth of 3 feet.

The type is of very small extent in the county. Several small tracts occupy the tops of the highest ridges in the vicinity of Leigh in the eastern part of the county, while two small areas occur in the western half of the survey. It is usually found associated with the Orangeburg sandy loam or Susquehanna sandy loam.

The Orangeburg loamy sand is of similar origin to the sandy loam member of the same series and differs solely in being formed from deeper accumulations of sandy material. It has a gently rolling topography, is excessively drained, and often subject to drought during the summer months.

Its adaptation to special crops is not recognized, or at least not taken advantage of, as it is planted to cotton and corn. The yields are light, chiefly on account of its lack of organic matter. The same recommendations for overcoming this defect apply as in the case of the Orangeburg sandy loam. The type is adapted to early truck crops where conveniently situated and sufficiently extensive to warrant the development of this branch of agriculture.

LUFKIN SILT LOAM.

The Lufkin silt loam in its typical development consists of a gray silt loam, from 5 to 10 inches deep, underlain by a stiff, tenacious gray clay extending to a depth of 3 feet or more and often showing yellow and red mottlings in the lower portions. Small mounds of a gray fine sand occur on some of the areas of the type.

Areas showing the characteristics of the Lufkin series have been mapped in this county as the Lufkin silt loam. Some show slight variations in texture, but these differences were not deemed sufficient to warrant the establishment of different types, owing to their small

extent. The smaller areas contain a fairly high percentage of fine sand and the larger ones have a rather thin mantle of silt loam.

The type is known locally as "post-oak flats," and occupies shallow depressions from 10 to 250 acres in extent within the Susquehanna and Caddo fine sandy loams, chiefly the latter type. The greater part of the type is found in the northeastern section of the county within a few miles of Caddo Lake. Many areas, too small to show on the map, are included with the other associated upland soils, particularly the Caddo fine sandy loam.

This type is very flat and receives fine sediment and considerable surface water from the surrounding soils. Its position precludes surface drainage and the impervious structure of its subsoil prevents underground drainage. Water stands upon its surface until evaporated.

The position and structure of the type point to an origin resulting mainly from the filling up of shallow depressions, possibly old lake basins, by the wash of fine material from the surrounding soil types. As the areas draining toward these depressions are comparatively small, the process is a slow one and deposition is still going on. The gray color of both soil and subsoil is largely due to imperfect aeration and oxidation.

The native vegetation consists chiefly of post oak, pin oak, red oak, and hickory.

None of the type is under cultivation, as it is not considered worth reclaiming under existing economic conditions. Artificial drainage is necessary before ordinary crops can be grown, and even then several years would elapse before good yields would be secured. As a general rule, drainage is practicable and may be accomplished by open ditches. Some pasturage is afforded, and it seems probable that the growing of certain grasses for this purpose or for hay would be successful and the best use to which the type could be devoted.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this series:

Mechanical analyses of Lufkin silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
443113.....	Soil.....	0.0	1.4	1.5	17.0	23.1	48.2	8.7
443114.....	Subsoil.....	.0	.8	1.1	11.2	16.6	36.0	34.1

SANDERS FINE SANDY LOAM.

The Sanders fine sandy loam consists of a brown fine sandy loam, from 10 to 12 inches deep, underlain by a fine sandy loam with mottlings of light brown, rusty yellow, and gray. The immediate

surface is often nearly black and the soil sometimes shows faint mottlings of different shades of brown. Both soil and subsoil may vary from a loamy fine sand to a loam, even within short distances, in the same bottom. A fine sandy loam seems to be the predominating texture. In the wider areas there are often small bodies of the Sanders silt loam. Thin strata of fine sand and pockets of gray fine sand are common throughout the subsoil, and small mounds of loose fine sand frequently occur on the surface. A substratum of mottled brown, yellow, and gray silty clay is often found at or near a depth of 3 feet. Gray is the predominating color in the more poorly drained areas. The portions of the type adjacent to the uplands usually have a reddish-brown color, owing to recent wash from the Susquehanna soils.

The type occupies comparatively narrow bottoms along many of the smaller streams and along the tributaries of the larger streams of the county. The topography is nearly level, with a perceptible slope in the direction of the stream flow. It is traversed by meandering stream channels from 2 to 6 feet deep. Drainage is often inadequate and the type subject to frequent short periods of overflow after hard showers. It also receives considerable seepage from adjacent uplands.

The Sanders fine sandy loam is composed of sediments from the drainage basin of the stream along which it occurs. The material has been held in suspension by swiftly moving water and deposited over the bottom during periods of overflow. A relatively small proportion of the material is in places colluvial in origin.

The forest growth consists of oak, elm, gum, maple, hickory, and other hardwoods.

Cotton and corn are the principal crops, the former yielding from one-half to three-fourths bale and the latter from 20 to 30 bushels per acre. Small patches of sugar cane are grown with good results. The stream channels should be straightened and wherever necessary open or tile drains constructed to obtain better drainage and to prevent damaging overflows. The type is easily cultivated and crops do not suffer from drought. Native grasses furnish pasturage where the forest growth is not too dense. This is a productive soil and worthy of immediate development and utilization for crops.

The following table gives the results of mechanical analyses of samples of soil and subsoil of this type:

Mechanical analyses of Sanders fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
443121.....	Soil.....	0.0	0.1	0.4	25.4	34.7	33.1	6.6
443122.....	Subsoil.....	.0	.0	.4	20.3	34.2	35.3	10.0

SANDERS SILT LOAM.

The soil of the Sanders silt loam is a dark-brown to nearly black silt loam, from 10 to 12 inches deep, often mottled with gray or drab. The subsoil is a gray to light-brown silty clay loam to silty clay, with mottlings of dark brown and rusty yellow, extending to a depth of 3 feet or more.

The color of the type is influenced by drainage facilities, gray being the dominant color of the more poorly drained areas, while the better drained portions of the type are brown. A substratum of fine sand or fine sandy loam usually underlies and is sometimes encountered within the 3-foot section. Pockets of gray to brown fine sand may occur in both soil and subsoil. Small sand mounds and a thin mantle of sandy material are often found on the surface. There is usually a narrow strip of fine sandy loam along the banks of streams.

The type occupies more or less extensive bottoms along the middle and lower courses of Eight Mile, Potters, Colliers, Mason, Hatleys, Moccasin, Grays, Haggerty, Prewitt, Quapaw, and Little Cypress Creeks and of Harrison, Quapaw, and Cross Bayous.

The type is practically level and slightly higher near the banks of the streams, the slope downstream being very gradual. Many old stream channels and cut-offs traverse the type. It is subject to frequent short periods of overflow and drainage is slow and inadequate. The small, unproductive patches, which occur in the cleared fields, are doubtless caused by accumulations of soluble salts.

The Sanders silt loam is of alluvial origin and composed of the fine soil particles, washed from the soils occurring in the drainage basins of the streams and deposited during periods of overflow. The sandy material, which is sometimes formed on the surface, has been washed over the type by moving waters of tributary streams.

White oak, post oak, pin oak, water oak, ironwood, hickory, sweet gum, maple, and ash constitute the forest growth.

A comparatively small proportion of the type is under cultivation, the cleared areas being farmed to corn and cotton. Corn yields from 20 to 35 bushels per acre and cotton from one-half to 1 bale. Numerous small patches of sugar cane are grown with good yields, producing a sirup of excellent quality. This crop should be planted more extensively.

The type is considered a strong soil, but the difficulty of clearing, which is greater than on the uplands, and the possibility of the damage or the loss of crops by overflow have retarded its development. Landowners should cooperate in straightening and deepening stream courses to improve drainage and lessen the damage to crops from

overflow during periods of high water. Lateral drains should also be built to care for the excess run-off. Such measures would also facilitate the use of machinery in the cultivation of crops.

No fertilizers are used, but liberal applications of lime would be beneficial in improving the structure of the soil.

The following table gives the results of mechanical analyses of samples of soil and subsoil of this type:

Mechanical analyses of Sanders silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
443139.....	Soil.....	0.0	0.0	0.4	7.3	16.3	55.1	20.9
443140.....	Subsoil.....	.0	1.0	.5	7.8	19.0	50.7	21.3

SANDERS CLAY.

The surface soil of the Sanders clay consists of a dark-brown to nearly black clay from 3 to 5 inches deep, resting upon a light-brown to brown clay mottled with yellow and drab, which becomes heavier with depth, grading at 15 to 20 inches into a stiff, mottled yellow, gray, and red clay. This stratum extends to a depth of several feet. The proportion of red increases with a corresponding absence of gray as drainage improves. The soil has a fairly large content of organic matter, is sticky when wet, and assumes a granular structure when dry.

The type occupies the greater part of the first bottom along Little Cypress Creek and Cypress Bayou, east of Bakers Bridge on the Marshall-Jefferson road.

With the exception of a few old stream channels and sloughs the surface of the type is level. It is subject to frequent overflow; in fact, a part of the type is usually submerged, as the water of the bayou and of the lake was at a very low mark at the time of the survey. Drainage is universally poor.

The Sanders clay represents the finer, reworked upland material, chiefly silt and clay deposited during long periods of overflow along the extreme lower courses of the Cypress drainage system.

The native vegetation consists of oak, gum, and a scattering of other hardwoods. Portions of the type along Cypress Bayou were formerly covered with a fine growth of cypress. None of the type is under cultivation. It is valued chiefly for its forest growth, but when drained and reclaimed would make a strong, fertile soil.

The following table gives the results of mechanical analyses of samples of soil and subsoil of this type:

Mechanical analyses of Sanders clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
443115.....	Soil.....	0.3	3.4	2.9	4.4	9.2	33.8	46.2
443116.....	Subsoil.....	.0	2.3	2.1	4.3	19.5	32.0	39.9

The following sample contained more than one-half of 1 per cent calcium carbonate (CaCO₃): No. 443115, 2.34 per cent.

TRINITY CLAY.

The Trinity clay consists of a dark-brown, stiff, silty clay to clay from 6 to 10 inches deep, underlain by a mottled yellow and gray clay loam to clay extending to a depth of 3 feet or more. The upper portion of the subsoil is mottled yellow and light brown when the gray mottlings do not appear above a depth of 15 inches. The yellow mottlings decrease and the gray mottlings increase in number and size with depth until at 3 feet the subsoil is usually a gray clay mottled with yellow. Gray is the predominating color of the subsoil of the poorly drained areas. The soil is sticky when wet and bakes and cracks when dry. The dark color of the soil is mainly due to the presence of organic matter.

In certain places, especially southeast of Boards Ferry, the type has been modified by a thin surface deposit of fine sandy loam. Here the soil is a black to grayish-black fine sandy loam underlain by the typical mottled gray and yellow clay subsoil. In other places, especially near the larger tributaries of the Sabine River, a thin mantle of silt covers the surface of the type. These phases are very limited in extent. A few mounds and areas of Kalmia sand, too small to show on the map, occur throughout the type. A narrow strip along the bank of the Sabine River has a lighter texture than the typical soil.

The type occupies the flood plain of the Sabine River from the western side of the county to Eight Mile Creek. In places it is nearly 2 miles in width, but is not continuous, being broken by an area of Kalmia fine sand and by the uplands extending to the river.

The type occupies a comparatively level bottom from 10 to 20 feet above the normal level of the Sabine River. It is highest near the banks of the river and slopes back toward the uplands. A number of sloughs and old stream channels traverse the type. A few small lakes are found within its limits. The type is overflowed only during seasons of excessive rainfall. Drainage is restricted and slow on account of the level surface and the retentive nature of the subsoil. No harmful concentrations of soluble salts were noticed.

The Trinity clay is an alluvial soil and is composed mainly of reworked material from the soils of the Houston series of the calcareous

prairies to the west. Adjacent to the streams, which are tributary to the Sabine River in the county, the type has been slightly modified by the additions of local sediment. This development of the Trinity clay is lighter colored than the soil as typically developed.

Valuable forests of oak, hickory, gum, and ash cover the greater part of the type. Scattering pine, hawthorn, and willows comprise the remainder of the forest growth.

Comparatively small areas are cleared and farmed to corn and cotton. These fields are located near the banks of the river and are better drained than the majority of the type. The farmers state that it is overflowed once in four or five years, usually late in April or early in May, and that corn planted after the flood waters have receded makes a good crop. In favorable seasons corn yields from 35 to 60 bushels and cotton from one-half bale to 1 bale per acre. On the better drained areas of the type alfalfa should do well if protected from overflow. Sugar cane proves a good crop and should be planted more extensively. The type would be greatly benefited by applications of lime and by artificial drainage by means of open ditches or tile. Protection from overflow is necessary before the type can be extensively developed. At present there is no economical manner of protecting it from overflow and it is valued chiefly for its forest.

KALMIA SAND.

The surface soil of the Kalmia sand is a brown to yellowish-brown medium to coarse sand, from 12 to 16 inches deep. The subsoil is a light-yellow medium sand extending to a depth of 3 feet or more. In places the soil has a mottled brown color with a few brown mottlings in the subsoil.

The type is limited in extent and found only in the Sabine bottom, where it occurs as a second bottom from 6 to 10 feet above the level of the Trinity clay. The largest areas of the type are near the junction of Eight Mile Creek and the Sabine River. Other small areas occur within the limits of the river bottom. It is comparatively level, well drained and not subject to overflow. A few sand mounds are present on the surface of the type.

The Kalmia sand represents the coarser part of the reworked upland material brought down by the streams and deposited in the more quiet flood waters of the Sabine River.

Some of the type is under cultivation. Pine, oak, and gum comprise the principal forest growth. Native grasses furnish pasturage during a large part of the year.

The isolated position of the type has retarded its development. Corn and cotton would do well and alfalfa would probably be successful.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Kalmia sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
443141.....	Soil.....	0.6	11.0	28.4	41.8	11.2	4.9	2.0
443142.....	Subsoil.....	.3	11.7	28.5	43.6	10.4	3.6	1.9

KALMIA FINE SAND.

The soil of the Kalmia fine sand is a gray to grayish-brown fine sand from 10 to 12 inches deep. The subsoil is a mottled light-yellow, brown, and gray fine sand extending to a depth of 3 feet or more. The type presents a marked uniformity in texture, but varies widely in color. The surface of the woodland areas is often dark gray, owing to the presence of decayed vegetation. Cleared areas sometimes show a brown mottled with gray, and at other times almost a pure gray, which changes to a yellow at a few inches below the surface. In the subsoil the relative proportion of colors varies in different areas of the type. The percentage of gray usually increases with depth. Small mounds of fine sand are common on the surface.

In the Sabine bottom, near Tallys, a part of the area of Kalmia fine sand consists of a number of parallel ridges from 25 to 200 yards in width, with intervening troughs. The soil in the troughs is a gray to mottled gray and brown fine sand, underlain by a very compact grayish fine sand, which in places is almost a hardpan. Below that is a mottled gray and brown clay loam to clay.

The type is underlain at a depth of 5 to 10 feet by the Trinity clay in the Sabine bottom and by the soils of the Sanders series in the bottoms of Little Cypress and other large streams of the county. Small areas of Trinity clay and of Sanders silt loam sometimes occur within the type. Both soil and subsoil of certain areas of the Kalmia fine sand along the creeks of the county have a reddish cast, due to the influence of the adjacent Susquehanna soils.

The Kalmia fine sand occupies a part of the second bottom along Harrison and Cypress Bayous, Eight Mile, Potters, and Little Cypress Creeks, and the Sabine River. Small areas also occur along other creeks of the county.

The topography is generally level, mounds, small depressions, and the ridges already mentioned furnishing local variation in the surface level.

The loose and porous structure of the type and its position insure good surface and underground drainage, unless the water table is too close to the surface. The position of the ground water level varies

in the different seasons, but it is rarely ever close enough to the surface to injure growing crops. The type is not subject to overflow.

The Kalmia fine sand is an alluvial soil, formed of reworked material from the Susquehanna fine sandy loam and other upland types of the survey. In places doubtless a small percentage of the finer material has been contributed by colluvial agencies.

The native vegetation consists of shortleaf pine, oak, gum, hackberry, and grasses. The type affords good pasturage where the forest growth is not too dense.

A large acreage of the type is farmed to cotton and corn. Yields of these crops are about the same as on the uplands, the average being slightly higher on account of diminished danger to crops by droughts. Yields decrease after the type has been under cultivation for several years, owing to the depletion of the supply of organic matter. Green manuring crops, such as cowpeas, should be sown after the last cultivation of corn and plowed under the following spring. A better method would be to include a legume as a member of a three or four year rotation of crops. This could be cut for hay and the stubble and roots turned under to supply organic matter. This type is probably the best soil of the county for the production of alfalfa. The drainage and moisture supply should be ample for the crop. Inoculation of the soil would probably be necessary in order to secure a good stand. Until recently the greater part of the type has been forested, which has retarded its development. A considerable acreage is now being cleared. It is regarded as a very desirable soil.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Kalmia fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
443119.....	Soil.....	0.0	0.2	1.2	64.6	23.7	7.8	2.6
443120.....	Subsoil.....	.0	.2	1.2	64.7	25.9	5.8	2.5

KALMIA FINE SANDY LOAM.

The soil of the Kalmia fine sandy loam is a gray to light-yellow fine sand to fine sandy loam from 12 to 18 inches deep. The subsoil is a yellowish-brown clay loam to clay mottled with yellow and gray. Red mottlings usually appear at a depth of 3 feet. Pockets of gray fine sand are common in the subsoil and mounds of gray to yellow fine sand are quite numerous in some portions of the type. The soil is loose and open, but the subsoil is stiff and almost impervious.

A phase of this type consists of a gray very fine sandy loam or silty fine sandy loam mottled with yellow and white to a depth of 12

inches, where it is underlain by a mottled red, yellow, light-brown, and gray clay. The soil is very compact and the subsoil is stiff and plastic. The phase has no sand mounds and is slightly higher than the adjoining areas of the type. Slightly better natural drainage probably accounts for the greater proportion of red in the subsoil. There is an area of about 1 square mile of this phase about 1 mile north of Baldwin.

The type occupies a well-defined terrace several feet above the first bottoms of Little Cypress Creek, Cypress Bayou, and of several of the larger streams of the county. This terrace is not continuous for any great distance. The largest areas are found in the northern part of the county.

The surface of the *Kalmia* fine sandy loam is level except for the local irregularities caused by the presence of mounds. Drainage is restricted by the level character of the surface and the impervious subsoil. Water often stands on the areas between the mounds and the water table is always fairly close to the surface. In a few places concentrations of soluble salts, locally known as "salt licks," occur. Such spots are devoid of vegetation and are fringed by a growth of salt-loving grasses.

The type is chiefly alluvial in origin and represents reworked material from the upland soils of the county. Near its boundary with the upland soils a small proportion of the material is colluvial in origin. Like the sand and fine sand of the same series, this type occupies well-defined benches or terraces, which are either remnants of a more extensive terrace or of an older bottom, or flood deposits, laid down under unusual local flood conditions. The fine phase of the type possibly represents an erosion terrace rather than one built up by successive depositions of sediments.

The native vegetation consists chiefly of oak, pine, hickory, and gum, with "black jack" on the sand mounds. Where the forest growth is thin native grasses afford good pasturage.

Practically none of this type is under cultivation, although where drainage is sufficient it should produce good yields of cotton and corn. Sugar cane and grasses should do well. A large part of the type would be greatly benefited by artificial drainage.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this series:

Mechanical analyses of Kalmia fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
443117.....	Soil.....	0.0	0.2	0.5	41.7	34.2	20.1	3.3
443118.....	Subsoil.....	.0	.0	.3	16.3	28.2	25.8	29.5

MEADOW.

Meadow is a variable type of bottom land found near the head of certain streams and along Caddo Lake. The portion along the streams is usually sandy and is both alluvial and colluvial in origin. That found along Caddo Lake is usually heavy in texture and is formed partly of lacustrine origin.

None of the type is under cultivation. It is subject to overflow; in fact that part of the type along Caddo Lake is overflowed the greater part of the time, as the survey was made during a period of very low water. The heavy areas of the type support a growth of salt grass. Other portions support a forest growth similar to that of the Sanders series.

Meadow is used for pasturage. Portions of it could be used for hay with good results.

SUMMARY.

Harrison County lies in the shortleaf pine uplands of the northeastern part of Texas. It has an approximate area of 872 square miles or 558,080 acres. The county was settled by immigrants from nearby States and was organized in 1842.

The topography is that of a dissected plain with rolling divides sloping steeply toward the bottoms of the larger streams. Certain sections of the county are hilly. The bottom-land areas are quite extensive. The surface of the greater part of the county is favorable for farming. Elevations range from 150 feet to 450 feet above sea level. The county is drained by the tributaries of the Sabine and Red Rivers. Drainage over the greater portion of the county is adequate in average seasons, but varies from excessive to insufficient in certain sections, depending upon seasonal conditions.

The climate is mild and the growing season about 8 months in length. Farm work may be carried on during every month in the year. The precipitation is usually ample and well distributed.

Between 30 and 35 per cent of the county is cleared. The remainder supports a forest growth consisting of pine and oak, hickory, gum, and other hardwoods. There are very few merchantable trees on the uplands, but some of the bottom lands have a valuable growth of hardwoods. Native grasses are abundant where the forests are not too dense.

The Texas & Pacific, Marshall & East Texas, Missouri, Kansas & Texas, and the Texas & Gulf Railways have a total mileage of over 131 miles within the county. These railroads furnish good shipping facilities in all directions. Marshall, the county seat, is a thriving city of 11,452 inhabitants and is the largest market and shipping point of the county. Hallsville, Harleton, Waskom, Elysian Fields, and Scottsville are other local shipping points of the county.

The county is well supplied with schools, churches, rural mail routes, and telephone lines.

The average price of farming land lies probably between \$10 and \$12 an acre, with a range from \$5 to \$25. About 48 per cent of the farms are operated by the owners. The average sized farm is 95 acres, classing each tenancy as a farm. There are a number of large holdings, especially in the eastern half of the county.

Five-sixths of the cultivated land is devoted to the production of cotton and corn. Peanuts, ribbon cane, potatoes, peaches, cowpeas, forage, and truck crops are also grown. The more progressive farmers are now beginning to diversify their crops and to practice rotation. Comparatively little improved farm machinery is used.

The soils of the uplands of the county belong to the Coastal Plains Province and have been derived from the weathering of sand and clay strata of Eocene age. The lowlands represent reworked material from this and other counties of the State. Including Meadow, 23 types have been mapped.

These fall naturally into two divisions, first the sedimentary or upland soils, including the Susquehanna series with five types, the Orangeburg series with four types, the Norfolk series with two types, the Ruston series with two types, the Caddo and Lufkin series with one type each; second, the alluvial or lowland soils, including the Sanders series with three types, the Kalmia series with three types, the Trinity series with one type, and Meadow.

The upland soils are fairly productive and easily cultivated. In general they are adapted to staple rather than to special crops, although peanuts, peaches, melons, truck, and other crops give good results on well-drained portions. The lowland soils are productive, but as a rule are poorly drained and subject to overflow. They are adapted to general farm crops and to ribbon cane. Alfalfa should do well on the Kalmia sand and the fine sand.

To increase the general agricultural production of the county a diversification of crops, which would enable the farmer to raise his home supplies and to make cotton his surplus money crop is necessary. This plan would permit him to practice a rotation of crops, which would increase the productiveness of the soil and enable him to maintain the yield of the cotton crops. Certain areas could be devoted to special crops for local and outside markets.

Other essential factors, which should receive attention, are an increase in the organic-matter content of the upland soils, the prevention of the erosion on the slopes, and the drainage of the alluvial soils.

The prevailing credit system, the outgrowth of tenant farming, with the high rate of interest charged under it, is also a factor retarding the agricultural development of the county.

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