SOIL SURVEY OF THE COOPER AREA, TEXAS.

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DESCRIPTION OF THE AREA.

The Cooper area comprises the southern part of Lamar County and the whole of Delta County, Tex. Lamar is one of the northern counties bordering on Indian Territory and is third in the tier starting from the northeastern corner of the State. The soil survey of the Paris area, completed in 1903, covers the northern part of the county, extending a short distance south of the Texas and Pacific Railway. The present survey completes the soil map of Lamar County and ex-

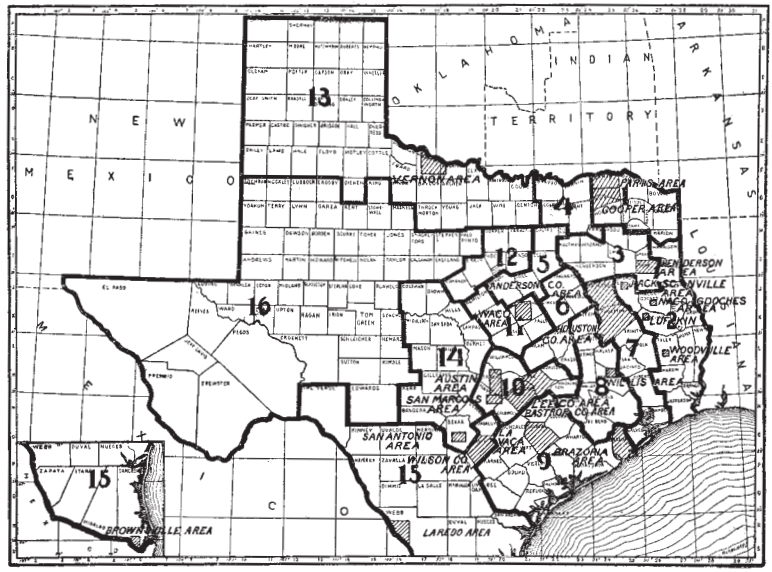

FIG. 23.—Sketch map showing location of the Cooper area, Texas.

tends directly south to include Delta County. Delta County is separated from Lamar by the north fork of Sulphur Creek and the south fork forms the southern boundary of the county. The area includes 400,256 acres or about 625 square miles.

The southern part of Lamar County is a rolling plateau, with a general slope toward the southeast. The entire drainage is effected through North Sulphur Creek by means of numerous small streams

that pursue almost parallel courses. The small streams have shallow valleys, but the stream beds have channels sharply cut into the soft underlying limestone of the prairie region. Nearly all of these streams are intermittent and become dry during short periods of drought. North Sulphur, South Sulphur, and Middle Sulphur have bands of low-lying bottom lands varying from one-half to 3 miles in width, through which the creeks meander from side to side. The smaller streams have less continuous strips of bottom land, and the lower and wider developments of their bottoms is due in many cases to deposits derived from the back waters of the larger creeks into which they empty. The lowlands are subject to overflow in every rainy season and throughout years of ordinary rainfall the bottoms are dotted with pools of standing water and traversed by old, partly filled stream channels. These lands are for the most part uncultivated, because of the overflow or the uncertainty of securing a crop. The drainage of Delta County is divided between the two forks of Sulphur Creek, the south fork receiving the greater portion. The upland portion of the area may be described as a rolling prairie with heavy black soils passing toward the streams into more hilly country with red sandy soils having a good growth of timber. This character of topography extends to the edge of the alluvial land with its dense growth of heavy timber.

Lamar County is one of the oldest counties of Texas, having been settled during the first colonization of the State between 1820 and 1845. The early settlers were a hardy class well able to withstand the hardships and dangers of the new region. They were largely from Tennessee, Kentucky, the Carolinas, and Virginia. The timbered portion of the country was first settled because of the plentiful supply of wood and water and also because the settlers were ignorant of the value of the black prairies, which at that time presented an uninviting prospect, except for grazing. The prairie region was very sparsely settled even up to the time of the outbreak of the civil war. Later experiments demonstrated the value of the black soils, and to-day the prairie is thickly settled and has an exceedingly prosperous appearance.

Paris, the county seat of Lamar County, is situated only a few miles north of the area surveyed, and near the center of the county. It is advantageously located on a main line of railroad and is the terminal point of three other systems. Its shipping facilities make it the center of an extensive wholesale trade, and it is the chief retail market for the Cooper area. The principal towns in that portion of Lamar County included in the survey are Roxton, Deport, Howland, Biardstown, Ambia, Minter, Milton, and Jennings. These towns have cotton gins and retail stores and furnish local markets for the produce of the area. Cooper, the county seat of Delta

County, is the largest town in the area. The other principal towns in Delta County are Ben Franklin, Pecan Gap, Enloe, Charleston, and Klondike.

The western side of the area is well provided with railroads, but the southeastern portion of Lamar County is without adequate railroad facilities. Lines are now under consideration, and it is hardly probable that the large timber areas of the Sulphur Creek and the town of Deport will be very long without a railroad.

Nearly all the products of the area except the principal crop, cotton, find a good local market, though a portion of nearly every product is exported. Alfalfa and other kinds of hay are demanded by the home markets, as well as all of the corn. Considerable shipments of poultry and eggs are made from the area. Cotton is ginned in the immediate neighborhood where it is grown and shipped from the most convenient railroad point.

CLIMATE.

The southern latitude of 33° 25′ gives this area a mild, equable climate, ordinarily free from extremes of heat or long-continued cold. The exceptions in winter are occasional "northers," which cause a sudden drop in temperature, in rare instances going below zero for one or two days. While uncomfortable and sometimes hazardous to stock, these cold waves do not interfere materially with farming operations, as they are of short duration. It is a general opinion that following crops are invariably improved by temperatures that freeze the soil to a depth of 3 or 4 inches. This takes place in a majority of winters. The extremes of summer temperature are not so marked. Although temperatures of 100° F. are not uncommon each summer, the humidity prevents too rapid loss of soil moisture, and thus the effects of drought are lessened. Unless a dry period comes in April or May when cotton is young, it is not apt to injure the yield, because cotton is a dry-climate crop. Usually the rainfall is in excess of that needed for cotton, the maximum crop being produced in the dry years of 1899 and 1900. A total crop failure owing to dry seasons has never occurred, although the yield may be somewhat reduced once or twice in a decade.

The average date of the last killing frost in spring and of the first in the fall, as deduced from records covering a period from 1898 to 1904, was March 26 and November 14 at Paris, and March 30 and November 14 at Sulphur Springs. The latest date of killing frost in spring for the same period was May 1, 1903, at Sulphur Springs, and the earliest in fall was November 3, 1899, at both Sulphur Springs and Paris. The figures show an average growing season of about 233 days, and as all farm crops mature in much less time, considerable latitude is allowed the farmer as to time of planting and

harvesting. Two crops of Irish potatoes can be grown annually if northern-grown seed is used in the spring.

Cotton picking begins in August and September and is continued as late as January. Farm work, with slight interruptions, may be carried on at any season of the year. Pasturage is good nine months in the year, and cattle with little feeding can graze throughout the winter. It is thus seen that cattle, hogs, and other stock can be raised at very moderate expense. On the whole, the climate is mild and healthful, free from destructive extremes, and favorable to all crops now grown, as well as many to which little or no attention is paid at present.

The following tables show the normal monthly and annual temperature and precipitation at Paris and Sulphur Springs, and also the dates of last killing frost in spring and the first in fall from 1898 to 1904, inclusive. It will be noted that the rainfall is greater from March to July, inclusive, which is the most active period of crop growth.

Normal monthly and annual temperature and precipitation.

Month.	Paris.		Sulphur Springs.		Month.	Paris.		Sulphur Springs.	
	Temperature.	Precipitation.	Temperature.	Precipitation.		Temperature.	Precipitation.	Temperature.	Precipitation.
	°F.	*Inches.*	°F.	*Inches.*		°F.	*Inches.*	°F.	*Inches.*
January	44.8	2.19	45.2	2.51	August	82.5	1.68	83.4	2.51
February	43.6	1.70	45.8	2.30	September	76.3	2.54	78.4	2.93
March	55.4	3.21	57.0	3.64	October	66.3	2.24	67.8	1.22
April	65.1	3.20	66.0	3.15	November	54.5	2.87	56.4	3.39
May	71.9	3.28	73.7	4.84	December	----------	----------	46.6	3.10
June	79.0	3.34	80.3	3.01	Year	----------	----------	65.3	37.04
July	82.8	3.12	83.1	4.44					

Dates of first and last killing frosts.

Year.	Paris.		Sulphur Springs.	
	Last in spring.	First in fall.	Last in spring.	First in fall.
1898	Mar. 28	Nov. 10	Mar. 27	----------
1899	Apr. 1	Nov. 3	Apr. 1	Nov. 3
1900	Apr. 12	Nov. 12	Mar. 16	Nov. 11
1901	Apr. 3	Nov. 16	----------	Nov. 16
1902	Mar. 19	Nov. 27	Mar. 18	Nov. 27
1903	Mar. 24	Nov. 17	May 1	Nov. 18
1904	Mar. 4	Nov. 10	Mar. 28	Nov. 11
Average	Mar. 26	Nov. 14	Mar. 30	Nov. 14

AGRICULTURE.

The first settlers of the Cooper area, being without transportation facilities, produced the crops that supplied the immediate necessities of pioneer life. On their farms in the woodland along the streams

they produced corn, wheat, and pork, while the broad prairies furnished pasturage for their cattle. Although the land was at first held in large tracts, cattle raising was carried on only in connection with farming and not on so large a scale as in other parts of the State. The tough sod of the virgin prairie furnished a supply of good native hay, but the quantity of this hay produced has gradually decreased as the prairie has been brought under cultivation and the grass sod destroyed. Many of the early settlers came to Texas in search of good cotton land, and as soon as practicable they attempted to grow cotton on the alluvial lands, and as early as 1845 it had become the leading crop. Since that time cotton and corn have been the principal crops. After 1860, cultivation was extended to the prairie soils and for a time wheat was an important crop on the black waxy land, but its cultivation was finally abandoned. The principal development of agriculture in recent years has been in the steps taken toward a diversification of crops. Alfalfa has met with favor, and though its spread has been hindered by failures during the exceptionally wet years, it has established itself as a very profitable crop and it will eventually be extended over the soils adapted to its cultivation.

Cotton is the great money crop of the area and the prosperity of town and county is dependent upon the income from this product. Lamar County produces from 50,000 to 60,000 bales of cotton and Delta County from 20,000 to 25,000 in average years. This part of the State is noted for the good quality of its cotton. It seems that some peculiarity of the soil, together with the slight attention that has been given to selection, has produced a grade of long-staple upland cotton superior to that grown on similar soils in other sections. Corn of fair quality is grown throughout the area and good hay may be secured at small cost, but as neither of these products is raised in sufficient amounts to supply home needs, a considerable quantity of each is shipped into the area and sold at high prices. Hence it follows that a considerable part of the money realized from the sale of cotton goes to buy feed products that could be profitably grown on the farm. Dairying on an extensive scale has been neglected, though farmers and small dairymen supply the local markets. Dairy products, while they do not bring so high a price as in some cotton-growing communities, are sure of a ready sale at remunerative prices, Butter of good quality seldom brings less than 25 cents a pound and milk ranges in price from 25 to 35 cents a gallon. Little attention has been given to breeding cattle for dairy purposes or the beef market. Some good Jerseys may be seen, but the great majority of cows are of scrub or native stock. The quality of hogs kept by the farmers would be creditable to any community. As a rule only a few head are kept to consume the waste about the farm. The high price of feed pre-

vents the feeding of hogs on a large scale for butchering, but some are raising highly bred hogs to sell at a fancy price. Considerable attention is given to poultry by the farmers, and wagons run regularly through the country to gather up chickens, eggs, and turkeys, and these products are shipped by the carload from the larger towns.

On the lighter sandy soils peaches and small fruits may be grown. North of this area, and near Paris, trucking and fruit growing are important industries on the sandy soils, but here, with the exception of a canning factory that has been operated profitably at Cooper, these products have been grown only to supply home needs.

With regard to soil adaptation, it is generally recognized that the black prairie soils are not well adapted to orchard fruits, especially the peach, so these fruits are confined to the more sandy soils of the Lufkin series. Cotton and corn are grown on all types of soil, but the black and gray soils of the Houston series are most productive. So far, alfalfa has been profitably grown only on the black prairie land, or Houston black clay, and though it is not known why this is so, the crop has resisted all attempts to produce it successfully on other types of soil. Some measure of success has been attained in a small way with alfalfa on the Houston loam, but no stand has been secured on the soils of the Lufkin series. The adaptation of the Houston black clay to alfalfa will in time add to its value.

Until 1901 there had been a steady rise in all land values in Lamar and Delta counties, the best of the black prairie having risen in price to $75 and $80 an acre and other soils to figures ranging from $25 to $60 an acre; but the abnormally heavy rainfall of the last few years has caused a decline in the prices of all land, the decrease being greatest in the case of the black prairie land on account of its lack of drainage. The black and gray prairie lands now bring from $40 to $60 an acre and the more sandy soils from $15 to $25 an acre. Ordinary timbered lands subject to overflow are worth from $5 to $10 and good timber land is rated at a higher figure. As records show that no perceptible permanent change in climate takes place a return to drier or more normal conditions can be expected, and there is no reason why land should not go to a price even higher than before the decline.

According to the census of 1900, about one-fourth of the farms are operated by the owners. The remainder are farmed by tenants who pay a certain share of the crop for the use of the land. The black prairie lands are more generally cultivated under the tenant system than the poorer sandy lands, because the owners of the better land prospered so that they could join the retired farmers in the towns and also because this land offers a better opportunity for speculation to the nonresident. There are, however, very few large tracts of nonresident ownership. The tenant system here is by no means so

objectionable as in many of the cotton-growing communities. The land holdings are not usually large, and often the owner lives upon and cultivates the adjoining farm. The tenant system as a whole, however, hinders agricultural progress, as it stands in the way of the introduction of better cultural methods and the practice of crop rotation.

Farm laborers are drawn mostly from the white races during the greater part of the year, as few negroes live in the county, but during the cotton-picking seasons the farmers go into the towns and induce the negroes to go to the cotton fields. At such times it is a common sight to see the farmers hauling loads of cotton pickers to and from their work. The usual wage of a day laborer is 75 cents to $1 a day, while $17 with board is the common monthly wage. During the busy season or when help is scarce wages may be higher. The usual price paid cotton pickers is 75 cents for each 100 pounds of seed cotton, but sometimes the price rises to $1. Expert pickers at these prices easily earn $2 to $3 a day.

The agricultural methods in use in the Cooper area do not differ materially from those practiced elsewhere in the cotton States, but conditions are now ripe for a change, and this change is already taking place, though gradually. The ruling high price of cotton is a great temptation to the farmer to specialize on this one crop. In the past this has been the natural course, and it would have been idle to suggest any other, but the question now is not altogether one of immediate returns, but the future productiveness of the soil must be looked to, and the sooner this is done the easier it will be to maintain crop yields. The soils of this section have held up well under the continuous cultivation of cotton, but a decrease in the average yields is noticeable, and this decrease may be expected to continue at an accelerated rate unless a proper crop rotation is practiced and humus is restored to the soil.

The farmers have displayed a commendable desire to improve their cultural methods, and the experience of the more daring and progressive has clearly shown the way along which advancement must be made. A diversification of crops is, first of all, demanded. Even at a seeming sacrifice the farmer must cease to grow the one crop, cotton, and by a proper rotation produce more of the necessaries of life. In the second place, a leguminous crop, as cowpeas or alfalfa, should be a member of the rotation. On the black prairie, where alfalfa can be grown, it should by all means be one of the most important crops. The experience of those who have grown this crop for many years show how profitable it is as compared with cotton. One farmer near Enloe, through a series of unfavorable years, has averaged more than 3 tons of alfalfa hay to the acre, and the price obtained has ranged from $10 to $12 in fall to $18 in the spring.

The gross returns from such a crop exceed those from a like acreage in cotton, and where the difference in the labor required and the acreage that one man can handle is considered the profit from alfalfa is very much greater. Besides this the benefit to the land is one of the most important considerations. Where alfalfa can not be grown, cowpeas, clover, and other nitrogen-supplying crops should be tried.

There are some difficulties to be met here as elsewhere by the successful farmer. The cotton boll weevil has appeared in this part of the State, and though this is its second season and it has not proved so destructive as was feared, it will still require care on the part of the farmer to combat it. It will be necessary to plant as early as possible and to grow as early maturing varieties as can be obtained.

A matter of utmost importance to the farmer of this section is the proper selection of seed. This is especially true in reference to corn. The corn grown in the Cooper area is not of the quality and quantity that might be obtained. The truly wonderful results that have followed the intelligent and systematic selection of seed corn in other States could no doubt be repeated here. Seed brought from a distance would hardly be successful here; the selection must be carried on under very different conditions of climate and soil. The improvement of cotton by seed selection has been carried on in all parts of the South for several years with good results, and now that an association has been formed to promote the improvement of corn it is to be hoped that the farmers of this area will give the work their hearty cooperation.

SOILS.

The upland soils of the Cooper area have been derived from rocks of Cretaceous age and owe their present condition to a long exposure to the agencies of erosion and weathering. Before the Cretaceous period the whole of the eastern part of Texas was included in the floor of a great inland sea, upon which was deposited the sediment brought down by streams and the remains of organisms living in these waters. At the close of the Cretaceous period the whole of this region was elevated above sea level and the rocks have since weathered into their present condition.

There are two formations from which the residual soils of the area have been derived. The Austin chalk, the older, extends from the northern border of the area southward below Enloe in Delta County, but the exact boundaries of this formation have never been closely defined. It consists of an impure chalk with bands of unconsolidated clays and marls. The weathering of the more calcareous, chalky portion of this rock has produced the heavy black prairie soil of the southern part of Lamar County and the northern part of Delta

County and the heavier gray and brown soils associated with it. The upper stratum, known to geologists as the Taylor formation, consists of layers of soft limestone, clays, shales, and marls, which when weathered produce soils very similar to those of the Austin chalk. No line of demarcation can be drawn between the soils of the two formations, as local variations are greater than the general differences in the character of the soils of the two formations.

The Houston black clay is formed from the more calcareous portion of the rocks of both ages, where the conditions for weathering have been favorable, and the black color of this soil is due to the decay of organic matter in the presence of the lime. The Houston loam represents gradation from the Houston black clay to the more sandy and lighter colored soils of the Lufkin series. It is probable that this type owes its origin in some places to a mixture of the other soils, but more often to the direct weathering of a less calcareous portion of rock. The Lamar loam is due partly to the character of the original rock from which it was derived and partly to the fact that erosion has kept the top soil washed off too rapidly for complete weathering into the Houston black clay. The Franklin loam, lying at the bottom of slopes of Lamar loam, is the wash from the latter type. The soils of the Lufkin series represent the weathered product of the shales and clays of the Cretaceous rocks. The Wabash clay, like the Franklin loam, is an alluvial soil. It borders all the larger streams of the area. The sediments from which it has been formed have been washed from the more calcareous soils of the upland, but principally from the Houston black clay, which it resembles in color and texture.

The following table gives the name and actual and relative extent of each of the several types of soil mapped in the area:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Houston black clay	166,272	41.5	Lamar loam	5,696	1.4
Houston loam	76,928	19.2	Franklin loam	1,280	.3
Wabash clay	61,248	15.3	Susquehanna fine sandy loam	128	.1
Lufkin fine sandy loam	51,520	12.9			
Lufkin clay	37,184	9.3	Total	400,256	

HOUSTON BLACK CLAY.

The soil of the Houston black clay, to a depth of 6 to 10 inches, consists of a deep black or drab clay, which has a most tenacious gummy consistency. The subsoil, to a depth of 36 inches, is usually a drab clay somewhat more plastic than the soil. Below 36 inches the subsoil becomes brown or yellow in color, and in some places where

the rock approaches the surface the entire subsoil may be of this color, passing into the chalky material from which the soil is derived.

The surface soil of the Houston black clay when drying breaks up into innumerable small blocks, which gives it a loamy character and permits of easy cultivation, but when thoroughly dried and further shrinkage takes place cracks several inches wide appear over the surface. The soil when wet assumes a sticky, gummy condition and becomes tenacious to a remarkable degree, so that when vehicles are driven over it, the mud adheres to the wheels in such masses that unless they are cleaned frequently travel is impossible.

The subsoil of the Houston black clay is somewhat impervious and where the drainage is not good the accumulation of water in the soil in seasons of heavy rainfall is injurious to crops.

The Houston black clay occupies large irregular areas covering the southwestern part of Lamar and the northwestern part of Delta County, the largest unbroken areas occurring between Cooper and Pecan Gap. The soil may be seen to the best advantage where the rocks have weathered deeply west of Enloe and north of Rattan. Except in the alluvial upland detached areas of the type occur over the whole of the southern part of Lamar and the northern part of Delta County associated with areas of Houston loam, and the one type passes so gradually into the other that in places no definite boundary can be drawn.

The surface of the Houston black clay is rolling, and while the type usually occupies the tops of broad gently rolling plateaus, no rule can be made as to its position on the slopes or hilltops, as this is dependent upon the character of the material from which it is derived, more particularly upon the amount of lime in the original rock.

The Houston black clay is a residual soil derived by weathering from two calcareous formations, the Austin chalk, which occurs in southern Lamar and as far south as Enloe in Delta County, and the Taylor formation south of that point. There are no marked differences in the character of the soils of the two kinds of rock. There are other formations, of Cretaceous age, that have produced the type in other parts of the State. The soil is calcareous and the deep black color is due, it is believed, not to an unusually large proportion of organic matter, but to changes taking place in organic matter decaying in the presence of lime.

The Houston black clay is everywhere a productive soil. It occurs in detached areas and belts throughout the Cretaceous formation of eastern Texas, and its presence is always marked by thickly populated and prosperous farming communities and growing cities. Dallas, Fort Worth, Houston, San Antonio, Waco, and Paris are situated on or near the Houston black clay or its associated types. In late

years excessive rains have so decreased crop yields on the Houston black clay that it has declined somewhat in value and the Houston loam has supplanted it in popular favor on account of its less impervious soil and its rolling topography. The Houston black clay has, however, a higher value than that at which it is now rated, and doubtless when drier years come it will assume its old place in the estimation of land owners. A most valuable feature of this soil is its adaptability to alfalfa. At present cotton and corn are the principal crops. The yield of cotton is one-half to 1 bale and of corn from 30 to 40 bushels per acre under good cultivation. The yield of oats is good. The yield of alfalfa is 2 to 4 tons per acre. Alfalfa hay sells readily at a good price, making it one of the most profitable crops of the area.

The native prairie grass made good hay, but the turf has nearly all been plowed and destroyed. Bermuda grass covers the land well and makes good pasture. The greater part of the Houston black clay was originally a treeless plain, but some small strips of heavy hardwood forests are found, usually along streams where the prairie fires have not kept down the trees. A few scattering bois d'arc trees are still to be seen scattered over the prairie, and wherever protected this species grows up thickly, as this type of soil is well suited to it.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Houston black clay:

Mechanical analyses of Houston black 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.*	*Per cent.*
16385	Soil	0.0	0.2	0.4	1.8	3.2	57.2	38.0
16386	Subsoil	.0	.3	.2	1.4	4.2	55.7	39.1

HOUSTON LOAM.

The Houston loam, locally known as " gray land," presents a rather wide range of texture, but the usual composition of the soil is a heavy, rather silty loam, dark gray or brown in color, and having an average depth of 9 inches, underlain by a drab or brown clay. The soil is lighter in color than that of the Houston black clay and contains a larger percentage of very fine sand. It lacks also the extreme tenacity of the Houston black clay, and the roads over this type are better. The subsoil is but little less heavy than that of the Houston black clay, but is usually lighter in color.

The Houston loam occurs in all parts of the area except in the river bottoms. It forms a border between the Houston black clay and the more sandy soils of the Lufkin series. It also occurs where thin

strata of limestone have weathered on the surface and the calcareous materials have become mixed with the more sandy soils beneath.

The Houston loam embraces all gradations in texture and character of material between the heavy Houston black clay and the lighter soils of the Lufkin series. It is formed in some places by a mixture of the other soils, but more often its origin is due to less calcareous material in the original rock than in the formations that produce the Houston black clay. Like the latter type, the Houston loam occupies broad rolling prairies and covers some hilly areas. The rolling topography as well as the more pervious character of the soil insures good drainage. For this reason farming has been more certain on this type of soil than on the Houston black clay, so that now it is considered the most valuable land in the area.

Cotton with good cultivation will average three-fourths bale per acre, and corn 35 to 40 bushels. Alfalfa has not been generally successful on this soil. It is possible to grow alfalfa on the greater part of it, but it seems more or less difficult to get a good stand. The Houston loam withstands drought fairly well, as the subsoil is retentive of moisture. All things considered it is a valuable soil deserving of its present high reputation.

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

Mechanical analyses of Houston 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.*	*Per cent.*
16381, 16383	Soil	0.0	0.2	0.3	2.5	8.3	66.3	22.0
16382, 16384	Subsoil	.2	.2	.2	1.9	10.3	56.8	30.6

LAMAR LOAM.

The Lamar loam consists of a brown or yellow loam with an average depth of 12 inches, underlain by a calcareous clay of lighter color. The subsoil usually contains fragments of limestone, and lime concretions are often present. The soil where erosion has not been active is friable and easily tilled, but very little of it is under cultivation owing to its relatively low productiveness. It differs from the Houston loam in its lighter texture, abundance of calcareous material, and more rolling topography.

The Lamar loam occupies irregular strips along North Sulphur Creek. The greater part of the type is on the south side of the creek, only one area being found in Lamar County of sufficient size to be indicated in the map. There are, however, small spots of the type found in the Houston black clay areas, one of which occurs on the slope of the creek east of Clardy. The large area of this soil

stretches from the limit of the survey near Pecan Gap eastward along North Sulphur and across the Texas Midland Railroad, attaining a width of nearly 2 miles in places.

The greater part of the area is much eroded. It is cut by gullies and stream channels leading toward the creek. On account of the rough surface and its tendency to wash and gully very little of it is farmed. The land is used for pasture and has a straggling timber growth of oak and other hardwood trees.

The Lamar loam is derived from material of the same age as the Austin chalk, though it appears to be a very calcareous marl. Large shells characterize the material where the type is found and gravel deposits occur near the surface. The type owes its characteristics to the material from which it is derived and probably to the rapid erosion which has removed the surface before thorough decomposition into the black clay could take place.

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

Mechanical analyses of Lamar 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.*	*Per cent.*
16389	Soil	0.0	0.2	0.1	0.4	31.9	50.0	16.7
16390	Subsoil	.1	.4	.2	.9	37.6	45.1	15.9

The following sample contained more than one-half of 1 per cent of calcium carbonate ($CaCO_3$): No. 16390, 7.36 per cent.

FRANKLIN LOAM.

The Franklin loam is a brown fine sandy loam with an average depth of 10 inches, underlain by a lighter colored brown sandy loam. The subsoil varies in texture and may be either lighter or heavier than the soil. It has the brown color that characterizes the Lamar loam.

The type occupies a strip, several miles long and from one-fourth to 1 mile wide, along the bottom lands of the North Sulphur Creek and on each side of the town of Ben Franklin. It occurs at the foot of the slopes covered by the Lamar loam and on the border of the Wabash clay area which lies between the Franklin loam and the creek. This soil is plainly an alluvial type formed by wash from the hills covered by Lamar loam. It occupies a nearly level topography, but lies higher above the stream than the Wabash clay and is but seldom subject to overflow.

Although it has a favorable location and can easily be tilled, the Franklin loam is not highly esteemed for farming, and much of it

is not cultivated. The average yields are low compared with the rich Wabash clay. Cotton yields one-half bale per acre and corn 25 to 30 bushels. It would seem that with proper treatment this should be made a valuable type of farm land. Drainage is poor on the lower terraces and during the wet season the excess of water in the soil has doubtless helped to reduce the yields. The land should be thoroughly drained. Cowpeas or other suitable leguminous crops would doubtless be beneficial.

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

Mechanical analyses of Franklin 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.*	*Per cent.*
16377	Soil	0.2	0.3	0.2	1.2	38.9	48.8	9.9
16378	Subsoil	.1	.3	.3	1.6	35.4	49.7	12.5

LUFKIN CLAY.

The soil of the Lufkin clay is a silty loam, or less frequently a very fine sandy loam, having a depth of less than 6 inches. Where the sandy soil has a depth of more than 6 inches it has been called the Lufkin fine sandy loam. In the Lufkin clay areas the sandy top soil has sometimes been completely removed from small patches and the clay appears on the surface. The subsoil of the Lufkin clay is a compact, impervious, silty clay. The color of the subsoil is a drab or gray, mottled or flecked with red and yellow. The color depends upon the drainage and extent of the weathering; in flat, poorly drained localities the clay has a solid drab-gray or drab color, but where exposed, as on washed hillsides, it weathers to a uniform red. In texture the subsoil is a clay, containing much silt and very fine sand, the coarser grades of sand being absent. Both soil and subsoil run together when wet, like a quicksand, into an impervious mass. In dry weather the water does not readily come from beneath, and the crops consequently suffer from drought.

The Lufkin clay is found in nearly all parts of the area, usually occurring as irregular strips along stream courses. It is nearly always timbered and is locally known as "post-oak land" on account of the predominance of the post oak on the level, poorly drained portions. On the better drained portions hickory, several species of oak, and other hardwood trees are found.

The Lufkin clay is a residual soil derived by weathering from shales and sandy clays. Its existence along stream valleys is not easily accounted for, but it is doubtless due to the processes of weath-

ering by which the calcareous materials in the original rock were removed.

The Lufkin clay is cultivated to some extent and good farms may be seen on this type of soil in some parts of the area, particularly in the vicinity of Charleston in Delta County. The greater part of the type is given up to forest. North of Deport in Lamar County many farms have been abandoned, partly on account of the poverty of the soil and partly by reason of the general emigration of the tenant class to the western part of the State. The average yield of cotton on the Lufkin clay is low, ranging from one-fourth to one-half bale to the acre. The best farmers have been successful with corn, securing from 25 to 35 bushels per acre. The more sandy portions of the type are adapted to trucking and fruits, but nothing is done along this line on any large scale.

The average results of mechanical analyses, showing the texture of the Lufkin clay, are given in the following table:

Mechanical analyses of Lufkin 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.*	*Per cent.*
16391, 16393	Soil	0.2	0.6	0.7	10.8	28.7	44.3	13.7
16392, 16394	Subsoil	.1	.2	.5	7.2	22.5	40.5	29.1

LUFKIN FINE SANDY LOAM.

The soil of the Lufkin fine sandy loam is a gray fine sandy loam varying in depth from 6 to 30 inches. It contains the finer grades of sand and much silt, though the silt content is not so high as in the typical Lufkin clay soil. The subsoil is very similar to that of the Lufkin clay, consisting of a compact, impervious silty clay. In color it is a drab or gray, mottled with yellow or red, but weathered to a uniform red where it is exposed in washes or on hillsides.

The Lufkin fine sandy loam occurs in extensive tracts in the southeastern part of Lamar County and the southern part of Delta County. It is found in level prairies, as well as on the stream slopes. The deepest phase of the type is developed southeast of Cooper toward South Sulphur Creek. As a rule the drainage is better than that of the Lufkin clay; both the elevation of the type and the depth of the sandy soil prevent standing water on the surface. A large proportion of this soil on the high level stretches has been brought under cultivation for the reason that it is a productive soil, and as it was originally prairie it was easily prepared for farming. The productiveness as well as the treeless condition of these nearly level uplands is due, no doubt, to the amount of calcareous material that the soil contains. The lime content is greater near the bodies of the Houston loam, where the Lufkin fine sandy loam passes so gradually into

that type that the boundaries of the two can only be determined by the nature of the subsoil.

Cotton is the principal crop on the Lufkin fine sandy loam. The average yield is perhaps about one-half bale per acre, but larger yields are secured by good cultivation. Corn is grown to some extent and the yields are fairly good. The soil is well adapted to fruits and vegetables, but no trucking is done except to supply the local market.

The following table shows the texture of the soil and subsoil of the Lufkin fine sandy loam:

Mechanical analyses of Lufkin 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.*	*Per cent.*
16395	Soil	0.3	0.7	0.7	9.9	31.6	44.0	11.9
16396	Subsoil	.0	.3	.3	5.5	23.4	35.6	34.6

WABASH CLAY.

Throughout the region occupied by the Houston black clay and the soils associated with it, the wash brought down by the streams has formed alluvial lands having certain characteristics. In this area this alluvial land has been called the Wabash clay. It is a black clay loam or clay with an average depth of 12 inches, underlain by a dark-drab clay somewhat heavier and more plastic in character. In color and general appearance this type closely resembles the Houston black clay and in places the line between the two types can be determined only by the topography, but over the greater part of the area the alluvial soil contains more silt and very fine sand, the percentage of the heavier materials depending upon the manner of deposition and the distance from large areas of Houston black clay. The difference between the soil and subsoil of the Wabash clay is due to the amount of organic matter in the soil.

The Wabash clay occupies the low flood plains of North, South, and Middle Sulphur creeks and their larger tributaries. It is nearly all subject to overflow, and as floods may come at any time of the year ordinary farming on these bottoms is very uncertain. The type represents a large body of land of the very highest productiveness, but at present of no value except for the timber upon it and the inferior pasturage afforded by the wooded areas that are often flooded for weeks.

These black clay bottoms follow the creeks across the whole of north Texas and comprise hundreds of thousands of acres of land that ought to be of more economic value than they are at present. In Lamar and Delta counties the strips of Wabash clay follow the streams throughout the county and attain in places a width of sev-

eral miles. The most profitable way of utilizing these lowlands presents one of the most interesting problems of the area. Many plans have been devised to levee the creeks, but as any restriction of the width of the bottom overflow will increase the depth of the water in that proportion and the height to which levees must be built, the cost of such measures would be prohibitive. It has been suggested that parallel bois d'arc hedges would collect drift and soil so as to form a water-tight barrier. This method, however, would be uncertain and the formation of such a dam would take a long time, though it should be useful where the overflow waters are shallow. At the present time it seems possible to utilize these lands safely in only two ways—for pasture and for forests. To secure good pasture the land should be cleared or openings made in the forest. The present timber growth over the greater part of the land is valuable, consisting of hickory, oak, and bois d'arc. The latter tree does especially well on the black lands along the larger streams and the foresting of these areas with it would in time prove a most profitable investment. It is easily seeded or transplanted, grows very rapidly, and the wood is highly esteemed in this region for use in the manufacture of wagons and for other purposes where a hard, tough wood is required.

The table given below shows the texture of the soil and subsoil of the Wabash clay:

Mechanical analyses of Wabash 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.*	*Per cent.*
16379	Soil	0.1	0.1	0.2	1.1	7.8	53.4	36.9
16380	Subsoil	.3	.3	.3	2.2	8.0	42.3	45.7

SUSQUEHANNA FINE SANDY LOAM.

Only one very small area of the Susquehanna fine sandy loam appears in the Cooper area and this is found in the extreme northeastern part, where it occurs as a point running down from the north. The soil of the Susquehanna fine sandy loam consists of a red sandy clay loam having an average depth of 8 inches. The subsoil is a red clay mottled and streaked with gray. Over much of the surface of this type there is a thin layer of very fine sand ranging from 1 to 3 inches in thickness, and sand mounds from 1 to 2 feet high and 20 to 30 feet across are common.

The type is well drained, as it occurs in a region cut by many small streams. Very little of the type is cultivated in the Cooper area. Cotton yields about one-third bale to the acre and corn 15 to 20 bushels.

The following table shows the results of the mechanical analyses of a sample 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.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
16399	Soil	0.7	0.9	0.9	17.8	29.1	23.9	25.9
16400	Subsoil	.3	.5	.4	10.9	19.6	20.8	47.5

SUMMARY.

The Cooper area (400,256 acres, or 625.4 square miles) comprises the southern part of Lamar County, which has the north fork of Sulphur Creek for its southern boundary, and all of Delta County, which is triangular in shape, lying directly south of Lamar and between the north and south forks of Sulphur Creek.

The area is a high, rolling plateau broken by the valleys of North Sulphur and South Sulphur creeks and their small tributaries. All the larger streams have low flood plains varying from one-fourth to 3 miles in width and subject to overflow.

This part of Texas was settled early and the people are of American stock. The prairie portion of the area is thickly settled and many flourishing towns have sprung up. The area approaches within a few miles of Paris, a railroad center and the principal city in this part of Texas. Two railroads pass through the western part of the area, but the eastern side lacks railroad facilities. Cotton is the principal export crop and facilities are ample for ginning and marketing.

The climate of the area is mild during the greater part of the year, the only disagreeable feature being the sudden cold waves or "northers" in the winter months and occasional wind storms. A long growing season occurs between the last killing frost in the spring and the first killing frost in the fall, the average dates being March 26 and November 14, respectively. Farm work may be carried on at all seasons. Peaches and other fruits are almost sure crops. The rainfall is abundant, averaging more than 32 inches, and damage from summer droughts is rare.

Only about one-third of the farms of the area are operated by the owners. The large tenant class is mostly white. Cotton and corn are the principal crops, but the success of some farmers with alfalfa will no doubt make it a very important crop on the black prairie soil within a few years. But little fruit is grown and very little milk and butter are produced for sale. The grades of cattle are poor, but hogs are of good breeds. Poultry and eggs are shipped in some quantity. The farm labor is mostly white and wages are good. Land ranges in

value from $10 to $75 an acre for the black prairie to $10 to $30 for the sandy soils and river bottom.

The upland soils of the area have weathered from Cretaceous rocks which underlie the entire area. The more calcareous portions of the two principal formations, the Austin chalk and the Taylor formation, have produced dark-colored soils of the prairie, classed with the Houston series, while the shales and sandy clays of the same formations have produced the more sandy soils. There are also two alluvial types.

The Houston black clay is a deep black or drab black gummy, sticky clay, underlain at lower depths by the partly altered rock. A large part of the upland is prairie formed of this and related soils. When dry the soil is loamy and easily worked, but when wet it becomes so tenacious that it is almost impossible to drive over the roads. The type covers broad rolling prairies. The drainage is usually adequate, but in recent wet years crops have suffered from too much water in the soil. It is one of the most desirable soils of the area. Cotton yields as high as 1 bale per acre and corn 30 to 40 bushels. Alfalfa is grown with success and is the most profitable crop of the area.

The Houston loam, locally known as "gray land," is a dark-gray or brown heavy loam 9 inches deep, underlain by a drab or brown clay subsoil. Its topography is similar to that of the Houston black clay and its origin is the same. It occurs between areas of the latter type and the more sandy soils. In wet years the soil is more productive than the Houston black clay. Cotton yields three-fourths bale per acre and corn 30 to 40 bushels.

The Lamar loam is a brown or yellow loam 12 inches deep, underlain by calcareous clay of lighter color which usually contains limestone fragments and lime concretions. The type occurs on the slopes of North Sulphur creek and is hilly and broken. It is not very productive and very little is cultivated. It owes its origin to the character of the original rock and the rapid erosion of the surface.

The Franklin loam lies at the foot of the slopes covered by the Lamar loam, and is formed from the washed material. It is a brown sandy loam 10 inches deep, underlain by lighter colored sandy loam of varying texture. Although well situated it has a low agricultural value. Corn and cotton are the chief crops.

The soil of the Lufkin clay is a silty loam with fine sand to a depth of less than 6 inches. The subsoil is a characteristic mottled, compact, impervious silty clay. Both soil and subsoil run together when wet and form an impervious mass. It occurs along stream slopes and is derived from the shales and silty clays of the Cretaceous rocks. Some good farms are found on this type of soil, but average yields are low. Cotton yields less than one-half bale per acre. The greater

part of it is uncultivated, being timbered with post oak and other scrubby oaks.

The Lufkin fine sandy loam is a gray fine sandy loam 6 to 30 inches deep, underlain by a silty, compact, mottled clay subsoil similar to that of the Lufkin clay. This type occurs on the higher, more level prairies and is extensively cultivated. It is not so productive as the Houston loam which it borders in many places, but yields are good. One-third to two-thirds of a bale of cotton per acre is secured and corn yields well.

The Wabash clay is the typical black alluvial land found along streams in Houston black clay areas. It is a black clay or clay loam 12 inches deep, underlain by a dark drab clay more plastic than the soil. The land is subject to overflow and scarcely any of it is cultivated at present. It is a strong soil and makes heavy yields where it can be farmed.

The Susquehanna fine sandy loam is an unimportant type which occurs in one very small area. It is a red sandy clay loam, underlain by a red clay mottled with gray. Thin layers of sand and occasional sand mounds cover the surface. It has very little agricultural value in this area.

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