

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE TEXAS AGRICULTURAL EXPERIMENT STATION,
B. YOUNGBLOOD, DIRECTOR.

SOIL SURVEY OF BOWIE COUNTY, TEXAS.

BY

L. R. SCHOENMANN, IN CHARGE, W. I. WATKINS, E. J. CAR-
PENTER, WILLIAM T. CARTER, JR., AND M. W. BECK, OF
THE U. S. DEPARTMENT OF AGRICULTURE, AND T. H.
BENTON, OF THE TEXAS AGRICULTURAL
EXPERIMENT STATION.

HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1918.]



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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., August 19, 1920.

SIR: I have the honor to transmit herewith the manuscript report and map covering the soil survey of Bowie County, Tex., and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils, 1918, as authorized by law. This work was done in cooperation with the Texas Agricultural Experiment Station.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

HON. E. T. MEREDITH,
Secretary of Agriculture.

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MAP.

Soil map, Bowie County sheet, Texas.

SOIL SURVEY OF BOWIE COUNTY, TEXAS.

By L. R. SCHOENMANN, In Charge, W. I. WATKINS, E. J. CARPENTER, WILLIAM T. CARTER, Jr., and M. W. BECK, of the U. S. Department of Agriculture, and T. H. BENTON, of the Texas Agricultural Experiment Station.—Area Inspected by HUGH H. BENNETT.

DESCRIPTION OF THE AREA.

Bowie County is situated in the extreme northeastern corner of the State of Texas. Red River, which forms the northern boundary, separates Bowie County from the States of Oklahoma and Arkansas, and Sulphur River separates it from Cass County on the south. Its length from east to west is about 40 miles and its greatest width from north to south is 26 miles, along the western boundary. The county embraces an area of 914 square miles, or 584,960 acres.

Bowie County is made up of three physiographic divisions: (1) A broad ridge extending east and west through the central part, (2) extensive flats forming belts lying north and south of and at somewhat lower elevation

than the central ridge, and (3) the alluvial belts along the Sulphur and Red Rivers and their tributaries.

Each of these three physiographic divisions has distinctive topographic features, though in some places their boundaries are indistinct. In the central ridge the surface is undulating to gently rolling, but dome-shaped mounds or hummocks form a conspicuous detail feature. The mounds range in height from 2 to 5 feet and are 20 to 100 feet in diameter. In some places they are so numerous as nearly to coalesce, while in others they may be several hundred feet apart. Where they are numerous they give a billowy topography.

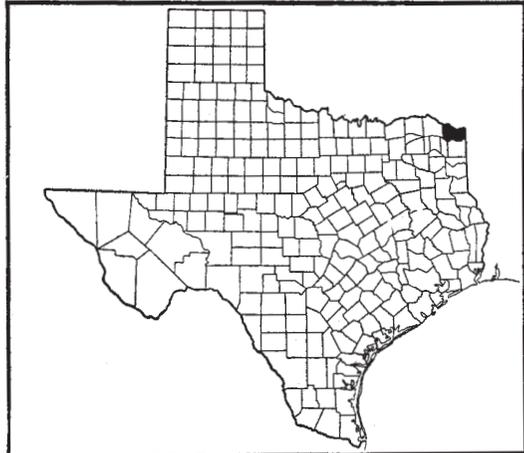


FIG. 1.—Sketch map showing location of the Bowie County area, Texas.

The flat belts are prevailingly level and benchlike, with narrow bands of sloping surface along the drainage ways. They are also characterized by low mounds similar to those existing in the central ridge. The river and stream bottoms have a flat and uniform surface, except for abandoned stream channels, which are numerous. The surface is slightly higher along the channels of the streams than several rods back. In the Red River bottoms this condition is especially well developed.

The central-ridge belt ranges in elevation from about 440 feet above sea level at Glass Hill, just south of Boston, to about 280 feet. De Kalb, elevation 407 feet; New Boston, 352 feet; Leary, 379 feet; Texarkana, 300 feet; and Maud, 289 feet, are all within the central-ridge belt. The flat belt to the south of the central ridge ranges in elevation from 250 to 280 feet above sea level. The flat belt on the north is probably of about the same elevation or only slightly higher. The Sulphur River bottom ranges in elevation from about 200 to 230 feet. No figures are available for the Red River bottoms, but the cultivated portions probably lie somewhat higher than the Sulphur River bottom. This gives an extreme range of about 250 feet between the overflow bottoms and the highest elevations in the central-ridge belt.

The Red River receives the drainage from the northern two-fifths of the county, and the remainder drains into the Sulphur River. The various tributary streams rise within the central-ridge belt and cross the bordering flat belt on either side. The drainage basins within the central-ridge belt are usually fan-shaped and made up of a ramifying system of branches which afford fairly adequate drainage, except where the run-off is impeded by the presence of numerous mounds. In the flat belts the tributary branches, while fairly numerous, are usually short and do not provide adequate drainage for any great distance back from the main stream course. All the principal drainage ways have developed flood plains, which follow the streams nearly to their sources.

The early settlers in this territory came mainly from Georgia, Alabama, Mississippi, and Tennessee. In recent years there has been some immigration from the North Central States, and during 1917 and 1918 quite a number of farmers from western Texas located in Bowie County. The present population consists almost entirely of native-born Americans. Of the total population of 39,472 in 1920, 27,992 was classed as rural, averaging 32.1 persons to the square mile. The agricultural population is concentrated in the central-ridge belt and the Red River bottoms. The Sulphur River bottom has practically no settlement, and the flats which flank the central ridge belt on the north and south are sparsely settled.

Texarkana, on the eastern county line, is situated partly in Bowie County and partly in Miller County, Ark. The part in Bowie County had a population of 11,480 in 1920. Texarkana is an important railway, manufacturing, and distributing center. It affords a good market for cotton, cottonseed products, live stock, dairy and poultry products, fruit, vegetables, hay, grain, and other farm products. New Boston, in the central part of the county, on the Texas & Pacific Railway, has a population of 869. A cotton-oil mill and cotton gins are maintained here. Boston, the county seat, is located $1\frac{1}{4}$ miles south of New Boston. De Kalb, on the Texas & Pacific Railway, is a shipping and trading point of local importance in the western part of the county. It has a population of 910.

Transportation facilities are good throughout the county. Texarkana is the junction of all the railroads serving the county. The Kansas City Southern Railway crosses the eastern part of the county, in a north and south direction, a short distance from the east county line. South of Texarkana it parallels the Texas & Pacific Railway, leading to Marshall, Tex. A branch of the Texas & Pacific passes through the central part of the county in an east-and-west direction. The southern part of the county is served by the St. Louis Southwestern Railway, which runs in a southwesterly direction from Texarkana, and crosses the Sulphur River about 10 miles east of the southwest corner of the county. No part of the county is over 15 miles from a shipping point, and all sections have direct connection with such markets as St. Louis, Memphis, Dallas, and Fort Worth.

The county is well supplied with public roads. About 80 miles of main road, radiating from Texarkana, have been graded and surfaced with gravel. The second-class roads, and the ungraded and unsurfaced roads in the Red River and Sulphur River bottoms are frequently unfit for heavy hauling during the winter months.

Practically all parts of the county are provided with rural mail delivery routes, and only the more remote sections are without telephone service. The local towns provide a good market for poultry products, which are shipped mainly to Texarkana and Fort Worth. These towns also receive the surplus butter, milk, and cream. Fort Worth is the principal live-stock market, but some of the better grades of beef animals and hogs are shipped to St. Louis. Buyers in the different towns provide a market for all the cotton available. This product is consigned mainly to Texarkana, Dallas, Galveston, and St. Louis.

CLIMATE.

The climate of Bowie County is characterized by long summer and short winter seasons. The average date of the last killing frost in

the spring is March 22, and that of the first in the fall, November 8. This gives an average growing season of 231 days. The latest recorded killing frost in the spring occurred April 12, and the earliest recorded in the fall, October 10.

The mean annual temperature, as recorded at Texarkana, is 64.4° F. The winter extremes have ranged from -9° to 85°, and the summer extremes from 51° to 109° F. During the winter months pleasant, sunshiny days, with comparatively cool nights, are interspersed with periods of cloudy weather or slow, gentle rains, frequently of 2 or 3 days' duration. The lower winter temperatures, which occur at intervals between the first part of November and the latter part of March, are seldom of more than 2 or 3 days' duration. They are due to cold winds from the north or northwest, locally known as "northers," and may be accompanied by sleet or snow. During these periods the ground may freeze to a depth of 1 to 2 inches. The snowfall at any one time seldom exceeds a depth of 3 or 4 inches, and snow does not remain on the ground long. The summer months form a period of uniform warm weather, favorable for the growth of the staple crops, corn and cotton.

The average annual precipitation of 40.19 inches is well distributed throughout the year and is usually adequate for crop needs. March, April, and May have a relatively heavy rainfall which sometimes delays preparation of the land and may retard planting on the bottom land and imperfectly drained upland soils. August, September, and October have a relatively light rainfall, favorable for the maturing and gathering of corn and cotton. Long periods of drought during the growing season are extremely rare, but short dry spells, especially if accompanied by hot winds, injure the corn crop at times. The spring rains are generally warm and gentle, and when not too heavy insure good seed germination. In the late spring thunderstorms, characterized by a short, heavy downpour, occur with increasing frequency. With the approach of the winter months the heavy local rains characteristic of the summer become less frequent, and the slow general rains of winter begin. The winter rains, owing to their volume, and those of the summer months, owing to their torrential nature, both cause destructive erosion on all the more pronounced slopes.

From the climatic data given below it will be seen that the climate of Bowie County is especially favorable to a broadly diversified system of agriculture. The freedom from great extremes of temperature favors dairying and stock and poultry raising.

The table following gives the more important climatic data, as compiled from the records of the Weather Bureau station at Texarkana:

Normal monthly, seasonal, and annual temperature and precipitation at Texarkana.

| Month. | Temperature. | | | Precipitation. | | | |
|----------------|--------------|-------------------|-------------------|----------------|--|---|----------------------|
| | Mean. | Absolute maximum. | Absolute minimum. | Mean. | Total amount for the driest year (1893). | Total amount for the wettest year (1905). | Snow, average depth. |
| | ° F. | ° F. | ° F. | Inches. | Inches. | Inches. | Inches. |
| December..... | 46.6 | 82 | 10 | 3.55 | 0.65 | 6.87 | 0.5 |
| January..... | 46.6 | 85 | 10 | 3.09 | .62 | 3.84 | .5 |
| February..... | 47.2 | 82 | -9 | 2.96 | .07 | 3.53 | .7 |
| Winter..... | 46.8 | 85 | -9 | 9.60 | 1.34 | 14.24 | 1.7 |
| March..... | 56.0 | 90 | 24 | 3.94 | 2.17 | 5.95 | 0.0 |
| April..... | 63.9 | 94 | 30 | 4.74 | 4.33 | 4.46 | 0.0 |
| May..... | 71.5 | 98 | 35 | 4.19 | 5.97 | 12.71 | 0.0 |
| Spring..... | 63.8 | 98 | 24 | 12.87 | 12.47 | 23.12 | 0.0 |
| June..... | 79.0 | 106 | 51 | 3.55 | 5.21 | 12.24 | 0.0 |
| July..... | 82.3 | 108 | 57 | 3.15 | 2.30 | 9.92 | 0.0 |
| August..... | 82.0 | 109 | 52 | 3.01 | 1.88 | 3.64 | 0.0 |
| Summer.... | 81.1 | 109 | 51 | 9.71 | 9.39 | 25.80 | 0.0 |
| September..... | 76.8 | 108 | 39 | 2.79 | 1.93 | 5.22 | 0.0 |
| October..... | 65.5 | 97 | 27 | 2.20 | 1.03 | 3.53 | 0.0 |
| November..... | 55.3 | 88 | 15 | 3.02 | 2.24 | 4.82 | 0.0 |
| Fall..... | 65.9 | 108 | 15 | 8.01 | 5.20 | 13.57 | 0.0 |
| Year..... | 64.4 | 109 | -9 | 40.19 | 28.40 | 76.73 | 1.7 |

AGRICULTURE.

The early settlers of Bowie County were farmers, and agriculture has been the dominant industry in its development. Boston and De Kalb were points of early settlement and the sandy soils of the central-ridge belt were among the first to be brought into cultivation. The early agriculture comprised the production of those products needed for self-sustenance. Corn, wheat, potatoes, and vegetables, with some cotton, were the chief crops. The cotton was marketed at Jefferson, Tex. Cattle and hogs were grazed on the prairies and in the timber. As the population increased and trading points developed, the growing of those products that could be more economically purchased was discontinued, and a large percentage of the cultivated land was devoted to cotton. This expansion of the cotton acreage was largely in the Red River bottom, where about one-third of the present cropped area was brought into cultivation under the plantation system. The better transportation provided by the railroads since about 1870 has further stimulated cotton production. The railroads

have also developed the lumbering industry in the shortleaf-pine belt of the southern and eastern parts of the county. During the last 15 years much of the cut-over land in this part of the county has been brought under cultivation, and the cultivated area in the Red River bottom has also been materially extended.

The agriculture of Bowie County centers around the production of corn and cotton, which occupy about 65 per cent of the improved land. Oats, peanuts, and cowpeas are fairly important farm crops, and a small acreage is devoted to alfalfa. Bermuda grass and prairie grasses are grown for pasturage and hay. Peaches, small fruits, and vegetables, including as of first importance sweet potatoes, are grown for home use and to some extent for market. A sufficient acreage is devoted to sugar cane and sorghum to meet the local demand for sirup and allow the utilization of part of the sorghum for forage. The raising of hogs, cattle, and sheep is steadily increasing in importance.

Cotton has occupied about an equal acreage with corn for a long period, but it is by far the most important crop commercially and leads all other farm products as a source of income. The 1910 census reports 29 gins in active operation in the county, and only two idle. The production of cotton fluctuates somewhat from year to year, but the present high prices have stimulated cotton growing and the crop of 1917 was about the largest on record, amounting to 32,370 bales of 500 pounds each. The amount of cotton ginned during the last ten years has fallen below 15,000 bales only in one year, 1915. Cotton is grown on all the well-drained soils of the county.

The census reports the area in corn in 1909 as 52,734 acres, with a production of 929,954 bushels, or an average yield per acre of 17.6 bushels. Corn is grown both for feeding on the farm and for sale. The production for the county practically meets the local requirements. Some farmers do not grow sufficient corn for their own needs, but many of those on the Red River bottoms produce a surplus for sale.

Oats are grown somewhat more extensively at present than in 1909, for which year the census reports only 952 acres in this crop. Part of the crop is cured for hay. The remainder, which is harvested and thrashed, is either fed on the farms or sold. The production of grain does not supply the local requirements.

Cowpeas are reported grown on 889 acres in 1909, and peanuts on 1,171 acres. The acreage in both these crops has been considerably increased in recent years. The local oil mills offer a market for peanuts, and this crop is becoming increasingly important as a source of income. Cowpeas and part of the peanut crop are used as forage and pasturage for hogs and cattle. In 1909 hay and forage crops occupied 2,462 acres. Of this 1,108 acres was in wild or prairie grasses, 461 acres in tame or cultivated grasses (chiefly

Bermuda grass), 602 acres in grains cut green (chiefly oats), and 83 acres in alfalfa. A ready market is available for all the hay crops, as the production supplies only a small part of the local requirements.

The acreage devoted to sorghum and sugar cane has increased somewhat in recent years.

Vegetables are grown mainly for home use, but in the vicinity of Texarkana truck crops, peaches, strawberries, blackberries, water-melons, cantaloupes, sweet potatoes, and Irish potatoes are grown for local marketing. Sweet-potato drying kilns, with a total capacity of about 12,000 bushels, are located at and near Texarkana.

The census reports 1,807 calves, 7,224 other cattle, 15,351 hogs, and 129 sheep and goats sold or slaughtered in 1909, with a total value of \$307,500. There are no large ranches, but cattle are raised on a small scale throughout the county. Most of the beef animals are produced on the farms operated by owners on the prairies and on undeveloped areas in the river bottoms. In general the beef animals are of rather inferior grade, but there are a few good herds of grade Hereford and Polled Durham cattle. The county has voted to undertake active measures for the eradication of the Texas fever tick, and dipping vats are being constructed (1918).

Hogs are quite generally distributed over the county, being raised on nearly all farms operated by owners and on many of the tenant farms as well. Poland-China and Duroc-Jersey are the most popular breeds for crossing with the unimproved stock.

The 1910 census reports 8,892 dairy cows on farms in Bowie County. The value of the dairy products produced in 1909, exclusive of those used in the home, is given as \$150,037. The dairy animals consist almost entirely of Jerseys or grades of that breed. Several dairy farmers near Texarkana sell milk and cream in that city. In the vicinity of the smaller towns there are a few herds of 3 to 10 cows, cream and butter from which are sold for shipment.

Poultry and eggs are produced in a small way on nearly every farm. Poultry products to the value of \$138,463 were produced in 1909.

Bowie County offers attractive opportunities for the development of dairying, the raising of horses and mules, and the production of pork, beef, and poultry products for market. Owing to the mild climate, grazing is possible during most of the year and expensive housing is unnecessary. An abundance of nutritious pasturage and forage can be provided by growing such crops as Bermuda grass, bur clover, lespedeza, vetch, cowpeas, soybeans, velvet beans, peanuts, oats, rye, corn, and sorghum. Transportation facilities are favorable for shipping dairy and live-stock products.

The crops and systems of agriculture vary somewhat with the character of the soils. On the prairies, occupied by the Crowley

silt loam, very little corn and cotton is grown, oats, peanuts, and prairie hay being the principal crops. A large part of the Crowley silt loam is in permanent pasture and the grazing of cattle is an important industry. The soils of the Red River bottoms, classed in the Pledger, Portland, Miller, and Yahola series, are used very largely for the production of corn and cotton. The heavier soils produce a relatively long staple of the commonly grown varieties of cotton (Rowden, Mebane, and Lone Star). The product is also of better grade, averaging strict middling, as compared with the average of middling for the upland soils. It is stated that these bottom-land soils will produce the so-called long-staple cotton, but none is grown at present. The centering of farm enterprise around cotton and corn production is probably due largely to the fact that these bottom soils are owned in large holdings and farmed almost exclusively by tenants. Crops are grown indiscriminately on all the well-drained upland soils. The alluvial Ochlockonee very fine sandy loam and silty clay loam, which are usually farmed in conjunction with various upland soils, are used mainly for corn and cotton. Most of the sugar cane, however, is grown on the Ochlockonee very fine sandy loam.

The clearing of land as ordinarily done is not very difficult or expensive. It usually consists simply of removing the merchantable timber and better firewood and burning the trunks of smaller trees and the undergrowth. The land is then considered ready for breaking and immediate cultivation. The stumps are allowed to rot out or are burned out in subsequent years.

Little fall plowing is done, and this is mainly confined to the prairies (Crowley silt loam). Plowing is done mainly in January, February, and March, when weather and moisture conditions are favorable, one-horse or two-horse turning plows being used. On the prairies fall plowing is usually broadcast, but elsewhere the prevailing practice is to bed on the "old middles."

For oats the land is flat broken. The seed is drilled in, usually during February, and on a rather poorly prepared seed bed. Early corn is planted on beds or ridges about March 15 or later, while late corn is planted in the "water furrow" about June 15. The seed is dropped rather thickly in the row by hand, and the stand is later thinned. The spacing in the row and the distance between the rows are usually greater on the sandy soils. Corn is given three or more cultivations with sweeps and shovels, and is hoed to keep down weeds in the row. When the crop is planted in the water furrow the soil of the ridges is gradually worked toward the corn in subsequent cultivations, so that when it is "laid by" the plants occupy moderate ridges. In harvesting corn the leaves are generally stripped from the stalks just as they are beginning to turn brown, tied in bundles, and hung on the stalk until cured, when they are stored for forage.

After the grain has matured the ears are snapped from the stalk and stored unhusked, the husks being used for roughage when feeding the corn. Cowpeas are frequently grown with corn, either in alternate rows or broadcasted at the last cultivation. When they are sown in the row or in alternate rows, the seed is planted between May 1 and June 1, and receives the same cultivation as the corn. The seed is picked by hand or the crop is grazed by stock.

Cotton is planted on ridges, which are previously leveled to some extent and in which fertilizer, when used, is applied with a distributor. The seed is drilled thickly with a one-horse cotton planter, about April 15. Sometimes weather and moisture conditions delay planting until well into May. After the plants are well up the rows are "barred off" by running a small turning plow close to the row and turning away a large part of the ridge, leaving the plants on a narrow strip. The plants are then chopped or thinned out with hoes to the desired distance apart in the row. Subsequent cultivation is performed with shovel plows, sweeps, and cultivators, the plants being left on well-defined ridges. Several hoeings are necessary to keep the rows free from grass and weeds. The crop is "laid by" about July 15. Picking begins in August and continues throughout the fall.

Peanuts are planted about May 20 to July 1, either on ridges or in the water furrow. The later planting is on land which has previously produced a crop of oats. Just before the plants appear the ground is harrowed lightly to break the crust. Later cultivation is given with sweeps, shovel cultivators, and hoes. The plants are harvested by running a flat blade attached to a cultivator under the plants at just sufficient depth to cut the tap root and loosen the vine. The vines with the peanuts attached are lifted from the loose soil and allowed to wilt, after which they are piled around stakes to cure. Peanuts are thrashed or picked by hand or machines, and the vines are used for stock feed. The fields are usually grazed by hogs. Pork from animals thus pastured and finished on corn is of high quality.

No definite system of crop rotation is generally followed in this county. On many fields, especially on the bottom-land soils, corn and cotton have been grown for a number of years successively or only in alternation. On the upland soils, where a great diversity of crops is produced, corn and cotton are rotated with such crops as oats, peanuts, peas, sorghum, and sweet potatoes, on at least a part of the cultivated acreage of each farm.

The census reports commercial fertilizers used on 5.7 per cent of the farms of the county in 1909, with a total expenditure of \$7,262. Considerably larger quantities are used at present than in 1909. Commercial fertilizers are used almost exclusively on the upland soils and mainly for corn and cotton. The applications formerly ranged

from 150 to 300 pounds per acre of mixtures analyzing 10-1.65-2.¹ But during 1918 the usual formula has lacked potash. Cottonseed meal and acid phosphate are bought separately by some farmers and mixed in varying proportions, the acreage application being usually 150 to 250 pounds for corn and cotton on the very fine sandy loam and fine sandy loam uplands, with slightly heavier applications for oats on the prairie soils.

The farm houses are, as a rule, substantial, but the numerous tenant houses are small and cheaply constructed. While the barns usually are small, they are large enough to house the work stock and store the various crops. The fields are well fenced, except on some of the larger plantations where the land is worked exclusively by tenants. Grain drills and harvesters, mowers, rakes, and hay presses are used where there is a sufficient acreage in crops requiring such machinery. There are a number of grain, cowpea, and peanut thrashers in the county. Riding plows, plows with more than one share, and 2-horse cultivators have not come into general use. On farms operated by owners up-to-date machinery is being adopted, but on the tenant farms the implements still consist mainly of planters, small turning plows, sweeps, and shovels of 1-horse draft, which, while capable of giving efficient cultivation of the usual inter-tilled crops, are not economical of labor. The work stock used on the farms consists of horses and mules of light to medium weight. Automobiles and trucks are replacing horses for heavy hauling and driving purposes where the road conditions are suitable.

In 1909, 22.3 per cent of the farms of the county used hired labor, at an average expenditure of \$103.56 each. Farm labor is performed largely by negroes. The principal outlay for labor is during cotton chopping and picking seasons. Ordinarily, labor is plentiful, but during the fall of 1917, when a pronounced shortage existed, from 75 cents to \$1.50 a hundred pounds was paid for cotton picking, and during the spring of 1918 the prevailing price for farm labor has ranged from \$1.50 to \$2.50 a day.

The census of 1910 reports 59.8 per cent of the area of the county in farms. The average size of the farms is 74.6 acres, 36 acres of which is classed as improved land. There are many farms that contain 200 to 300 acres, and some holdings comprise several thousand acres. Of the 4,480² farms in the county in 1910, owners operated 42.5 per cent, tenants 57.3 per cent, and managers 0.2 per cent. The prevailing system of renting is on shares. When the landlord furnishes the implements, work stock, and seed, allowing the tenant a garden plot and wood for fuel, and the tenant furnishes only the

¹ Phosphoric acid 10 per cent, nitrogen 1.65 per cent, and potash 2 per cent.

² The census classes each tenancy as a farm.

labor, the crop is divided equally between landlord and tenant. Where the tenant furnishes implements and work stock, the landlord receives one-fourth of the cotton and one-third of the corn. Cash rents range from \$3 to \$8 an acre, depending on the character of the land and the location.

The census of 1910 gives the average assessed value of land in Bowie County as \$12.34 an acre. There has been a general advance in the price of farm land in the last five years. The selling price varies with the character of the soil, the acreage cleared, the farm improvements, and the location with reference to markets, and ranges from \$15 to \$100 an acre. The higher prices are paid for land in the Red River bottoms adjacent to improved roads and on the uplands for land close to the larger towns. The selling price of unimproved land varies with the quantity and quality of the forest growth and the location.

SOILS.

The upland soils of Bowie County are derived from Coastal Plain material consisting of beds of noncalcareous sand, sandy clay, and heavy clay, and calcareous clay or marls. The various soils show a close relationship to the lithological character of the parent material, but in the course of their formation, weathering, oxidation, and vegetative growth have effected differences in their color, and erosion has altered the texture and depth of the surface material in places.

The soils are classified into types on the basis of texture, that is, the relative proportions of coarse sand, sand, fine sand, very fine sand, silt, and clay which the soil contains. Those types having common characteristics in topography, drainage, color of the surface soil and subsoil, structure, and origin are grouped into series. The beds of sand and sandy clay have given rise to soils of the Norfolk, Bowie, Ruston, and Orangeburg series. The heavy clays have produced the Crowley and Lufkin soils, but sandy clays have doubtless contributed in the formation of the surface material of the sandy members of these two series. The calcareous clays or marls have produced the Bastrop and Sumter soils, while the Oktibbeha soils, if not derived entirely from calcareous clay, have at least been influenced by such material.

The Norfolk, Bowie, Ruston, and Orangeburg types have gray to brownish-gray soils, but the subsoils, while all friable sandy clays, differ in color. The Norfolk subsoils are prevailingly pale yellow, the Bowie yellow in the upper part and mottled with red in the lower part, the Ruston reddish yellow to yellowish red, and the Orangeburg red.

The Susquehanna series includes types with gray to brownish surface soils, and red or mottled red, yellow, and gray, stiff, plastic clay subsoils.

The Crowley series includes the prairie areas with brown to brownish-gray surface soils and mottled red and drab or red, yellow, and drab stiff, heavy clay subsoils. The members of the Lufkin series are gray or mottled gray and brownish in the surface soil, with mottled gray and yellow or drab, compact, impervious clay subsoils. Both surface run-off and internal drainage are very poor.

The Oktibbeha series resembles the Susquehanna in the surface soil and upper subsoil, but is characterized by underlying calcareous clays or marls.

The Bastrop series is distinguished by its chocolate-brown surface soil and chocolate-red subsoil. Both soil and subsoil are calcareous.

The Sumter soils are dull greenish yellow, with greenish-yellow subsoils which grade into white, chalky material below. The members of this series are usually calcareous in the surface soil and highly calcareous in the lower subsoil. They occur in prairie areas.

The alluvial soils are rather extensive and quite varied in characteristics. They represent sediments washed from the drainage basin of the stream along which they occur and deposited from overflow waters. The alluvial soils are grouped into two divisions, first bottom or recent alluvial, and second bottom (terrace) or old alluvial. The recent-alluvial soils are subject to overflows and are added to at each successive inundation. The Ochlockonee series represents material derived chiefly from the noncalcareous upland soils, including the Bowie, Ruston, and Susquehanna. The Trinity soils occur where considerable alluvium has been contributed by the black prairie soils, both calcareous and noncalcareous, sufficient to impart the characteristic black color and the crumbly structure peculiar to the sediments from that region. Along the Red River the alluvium, while probably quite varied in origin, includes sufficient material washed from the peculiar chocolate-red Vernon soils of western Texas and Oklahoma to dominate the color either throughout the 3-foot section, giving rise to the Miller and Yahola soils, or in the subsoil portion, giving rise to the Portland and Pledger soils.

The soils of the Ochlockonee series are brown to mottled brown and drab in the surface portion, with brown or mottled yellow and gray subsoils.

The members of the Trinity series have black surface soils and brown to mottled gray and yellow subsoils.

The soils of the Miller and Yahola series are chocolate red in color. The Yahola differs from the Miller in having a subsoil coarser in texture and lighter in color than the surface soil.

The Portland soils are chocolate brown, with chocolate-red subsoils, while the Pledger soils are black, grading below into chocolate-red material.

The second-bottom or stream-terrace soils represent remnants of former first-bottom deposits laid down when the streams flowed at higher levels than at present. They lie above normal overflow and are noncalcareous. These soils are included in the Leaf and Myatt series.

The Leaf soils are gray to brownish or mottled gray and brownish in the surface portion. The subsoils are gray to mottled gray and yellow, grading into a substratum of mottled red and gray or red and yellow, tough, impervious clay. The internal drainage is impeded by this impervious substratum.

The Myatt soils are gray to dark gray. The subsoils are gray to mottled gray and yellow in color and impervious. The members of this series occupy the most poorly drained portions of the Coastal Plain stream terraces.

Riverwash includes materials of variable color and texture occurring along the Red River, where the soil could not well be separated into types.

In the following pages of this report the various soils of Bowie County are described in detail and their relation to agriculture discussed. The distribution of the soils is shown on the map accompanying this report, while the table below gives the name and the actual and relative extent of each:

Areas of different soils.

| Soil. | Acres. | Per cent. | Soil. | Acres. | Per cent. |
|---------------------------------------|--------|-----------|--------------------------------------|------------|-----------|
| Susquehanna very fine sandy loam..... | 70,144 | 18.0 | Crowley silt loam..... | 7,936 | 1.4 |
| Deep phase..... | 35,264 | | Yahola very fine sandy loam..... | 7,424 | 1.3 |
| Bowie very fine sandy loam.. | 95,936 | | Miller clay..... | 7,360 | 1.3 |
| Poorly drained phase..... | 4,992 | 17.5 | Lufkin silt loam..... | 7,040 | 1.2 |
| Heavy phase..... | 1,664 | | Miller very fine sand..... | 5,440 | .9 |
| Susquehanna silt loam..... | 28,992 | | Oktibbeha clay loam..... | 5,184 | .9 |
| Heavy phase..... | 20,736 | 8.5 | Leaf very fine sandy loam.... | 5,056 | .9 |
| Lufkin silty clay loam..... | 43,712 | | Yahola clay..... | 4,992 | .8 |
| Ruston very fine sandy loam. | 30,464 | | Riverwash..... | 4,736 | .8 |
| Deep phase..... | 128 | 5.2 | Norfolk fine sand..... | 3,840 | .7 |
| Ochlockonee very fine sandy loam..... | 27,520 | | Dark-colored phase..... | 320 | |
| Ochlockonee silty clay loam.. | 22,912 | | Bastrop clay..... | 3,136 | .5 |
| Susquehanna clay loam..... | 19,840 | 3.4 | Yahola silt loam..... | 2,944 | .5 |
| Ochlockonee clay..... | 19,136 | 3.3 | Orangeburg very fine sandy loam..... | 1,728 | .5 |
| Portland clay..... | 19,072 | 3.3 | Dark-colored phase..... |  |  | 1,152 |
| Bowie fine sandy loam..... | 14,144 | 2.4 | Portland silty clay loam..... | 2,560 | .4 |
| Pledger clay..... | 13,568 | 2.3 | Myatt silty clay loam..... | 2,432 | .4 |
| Susquehanna fine sandy loam. | 10,624 | 1.8 | Miller very fine sandy loam.. | 2,176 | .4 |
| Trinity clay..... | 9,728 | 1.7 | Portland very fine sandy loam. | 1,600 | .3 |
| Ruston fine sandy loam..... | 8,000 | 1.6 | Orangeburg fine sandy loam.. | 1,280 | .2 |
| Deep phase..... | 1,344 | | Sumter clay..... | 576 | .1 |
| Lufkin clay..... | 8,128 | | 1.4 | Total..... | 584,960 |

NORFOLK FINE SAND.

The surface soil of the Norfolk fine sand is a gray to brownish-gray fine sand passing at 4 to 6 inches into a pale-yellow, loose, fine sand which extends to a depth of 3 feet or more. In the forested areas the immediate surface layer is often dark colored, owing to the accumulation of organic matter. In a few places, especially on the river terraces, there are patches of Kalmia fine sand too small to be separated on the soil map. The surface soil is similar to that of the Norfolk fine sand, but the subsoil is in places a fine sandy clay, showing gray mottlings in the lower part of the 3-foot section. This particular variation is developed in the bottoms of the Sulphur River and its principal tributaries. Throughout the Norfolk fine sand there are included patches of Bowie fine sandy loam, marked by a few dome-shaped mounds.

The Norfolk fine sand is developed in the vicinity of Boston, Simms, and Siloam, and about 3 miles south of Hooks. It occupies knolls and gently rolling divides and in places extends down the valley sides to the drainage ways. The surface varies from undulating to rolling and surface drainage is adequate. Owing to the porous subsoil even the stream-bottom areas, which have a flat to undulating surface, are well drained.

This type is of small extent. Probably 80 per cent of its area in the upland is under cultivation, while that occurring in the bottoms is forested mainly with shortleaf pine, red oak, blackjack oak, willow oak, sweet gum, and hickory.

Corn and cotton are the principal crops. Corn yields about 8 to 15 bushels per acre and cotton about one-fifth or one-fourth bale, without fertilizer. The Norfolk fine sand is well suited to the production of early truck crops, berries, watermelons, cantaloupes, and peaches. It needs heavy fertilization, however, for best results, and legumes should be grown and plowed under as green manure.

Norfolk fine sand, dark-colored phase.—The Norfolk fine sand, dark-colored phase, has a surface soil of dark-brown loamy fine sand which passes at depths ranging from 8 to 16 inches into a subsoil of light-brown, loose, incoherent fine sand grading into yellowish-brown fine sand of similar structure. This phase occurs only in the northwestern part of the county in two small areas about 2 miles northwest of Spring Hill School. The surface ranges from undulating to rolling, and this, with the porous nature of the subsoil, insures good drainage. Most of the phase is used for the production of corn and cotton. The remainder is in timber, consisting of red oak, blackjack oak, scrubby post oak, and a species of willow oak. Farming methods are the same as on the Ruston fine sand. Yields average a little higher, corn giving 15 to 20 bushels per acre in favor-

able seasons and cotton about one-third bale per acre. The methods of improvement suggested for the Ruston fine sand apply equally well to this soil.

BOWIE FINE SANDY LOAM.

The typical Bowie fine sandy loam consists of 4 to 6 inches of brownish-gray loamy fine sand, passing into pale-yellowish fine sandy loam, which grades at 12 to 16 inches into pale-yellow, rather compact to slightly plastic fine sandy clay. The subsoil becomes more friable with depth, until at 20 to 24 inches it is a decidedly friable to mealy fine sandy clay, mottled yellow, red, and gray. Dome-shaped mounds of Norfolk and Ruston fine sand and deep Bowie and Ruston fine sandy loam are common on this type, but they are seldom very prominent or numerous. Over parts of the type, as near Simms, they are lacking or barely perceptible. In some areas gravel occurs on the surface or in the soil. These are indicated on the map by symbol.

The Bowie fine sandy loam occurs in relatively small areas in the higher parts of the central-ridge belt. It is most extensively developed in the vicinities of Siloam, Simms, Hooks, and Leary. The type occupies gentle slopes, low knolls, and undulating to gently rolling ridges or divides. Both surface run-off and internal drainage are good, averaging slightly better than on the Bowie very fine sandy loam.

Almost all of the Bowie fine sandy loam is cultivated. It was among the first soils to be settled, and many of the fields have been in cultivation for a long time. A small proportion of the type is in forest of pine, red oak, sweet gum, and hickory. Some of the forested areas are old fields which have grown up in pine.

The crops grown and the farming methods are similar to those in the case of the Bowie very fine sandy loam. The yields average slightly lower, but crops reach maturity somewhat earlier. In addition to the methods of improvement suggested for the Bowie very fine sandy loam, terracing and contour cultivation should be employed on the more pronounced slopes of this soil to control erosion.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Bowie fine sandy loam:

Mechanical analyses of Bowie 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> |
| 444810..... | Soil..... | 0.1 | 1.3 | 3.6 | 61.2 | 15.8 | 14.4 | 3.6 |
| 444811..... | Subsoil..... | .2 | 1.1 | 2.7 | 47.9 | 12.5 | 16.2 | 19.3 |

BOWIE VERY FINE SANDY LOAM.

The surface soil of the typical Bowie very fine sandy loam consists of 4 to 6 inches of dull-gray or brownish-gray loamy very fine sand, passing into pale-yellow very fine sandy loam. This grades at 10 to 16 inches into a subsoil of yellow, moderately friable very fine sandy clay, and this between 18 and 30 inches into mottled yellow and red friable very fine sandy clay. Through the lower subsoil red and gray mottling increases with depth and the material assumes a more friable to mealy structure, a feature distinguishing it from the Susquehanna subsoil, which it resembles in color. In some of the higher, better drained situations the upper subsoil has a slight reddish cast, as in the Ruston soils, but this quickly changes to yellow below. Dome-shaped mounds are common over most of the type. They vary considerably in size and abundance, being low and almost lacking in some of the areas, and in others very prominent and so numerous as nearly to coalesce, giving the surface a decidedly billowy or hummocky configuration. The soil of the large mounds consists mainly of Ruston very fine sand or the deep phases of the Ruston or Bowie very fine sandy loam. In the eastern part of the county the Bowie very fine sandy loam frequently is somewhat gravelly. The gravel consists of small, rounded chert and quartz pebbles. Areas in which gravel is plentiful in either the surface soil or subsoil are indicated on the soil map by symbol. In the vicinity of Moss Springs School a few small areas of Norfolk very fine sandy loam³ are mapped as the Bowie very fine sandy loam, and at various other places areas of other upland soils of similar textures are included, owing to the impracticability of showing areas of such small size on a map of the scale used in this survey.

The Bowie very fine sandy loam occurs extensively throughout the central-ridge belt and to a smaller extent along the principal drainage ways which traverse the bordering flat belts. Areas of considerable size are found near Texarkana, New Boston, and De Kalb, but a large number of small, scattered areas make up an important proportion of the type. For the most part this soil occupies very gentle slopes, but it also occurs on relatively low-lying flat areas, higher flats and low ridges and divides. Some of the flatter areas are imperfectly drained, but most of the land has moderately good drainage. The mounds where very numerous retard the run-off to some extent, but all the type is sufficiently well drained for cultivation.

This is an important agricultural soil, and one of the most extensive in the county. Probably three-fourths of it is under cultivation, much of it in relatively small farms operated by owners. The uncul-

³This type is not mapped in Bowie County. It consists of a gray very fine sandy loam grading into pale yellow and underlain at 12 to 16 inches by pale-yellow clay, containing enough very fine sand to make it friable, which extends to over 3 feet.

tivated portion is mainly in forest, consisting of a mixed growth of shortleaf pine, red oak, white oak, sweet gum, and hickory in the eastern, southeastern, and south-central parts of the county, and of red oak, blackjack oak, and hickory over the remainder of the county.

Cotton and corn are the crops of chief importance, followed by peas, peanuts, oats, and sorghum. Sweet potatoes, Irish potatoes, and vegetables are grown for home use and to some extent for local marketing. In the vicinity of Texarkana, peaches, pears, strawberries, sweet potatoes, and truck crops are grown for sale on the local markets and to a small extent for shipment. Many of the farmers have a small surplus of hogs, cattle, and dairy and poultry products for sale. These, together with cotton, are the main sources of income on the farms operated by owners, where practically all the feed and forage crops are consumed on the farm. On the farms operated by tenants the production is less diversified and cotton and corn are both cash crops, at least to the extent of the annual land rental. Yields of cotton range from one-fourth to two-thirds bale per acre. Corn yields 15 to 40 bushels. Oats and sorghum make moderately heavy yields. Cowpeas and peanuts do very well. They are used as forage for cattle and work stock, and also afford grazing for cattle and hogs. In some localities these crops are thrashed and marketed. Fruit and vegetable crops on this soil are comparatively early. Strawberries are in bearing from April 15 to May 15. Irish potatoes are ready for market from May 20 to June 1, and peaches about June 1 to 15. This soil seems better suited to pears than to peaches. Pears are ready for marketing about October 1. The Keefer is the principal variety grown, and it succeeds well where the orchards are given proper care.

Plowing on the Bowie very fine sandy loam is usually begun in January; 4 to 5 inches is the prevailing depth. A furrow is thrown from each side of the old ridge into the old middle to form the new ridge. Later the remainder of the old ridge is thrown to the new ridge with a turning plow or a "middle buster," and just before planting the ridges are leveled down with a log drag or harrow. Oats are seeded on flat-broken land, but most of the intertilled crops are grown on ridges except June corn, which is sometimes planted in the water furrow. Oats are mainly sown in the late winter (February), but a small acreage is sown in the fall to serve as a winter cover crop and provide some winter grazing. Early corn is planted about March 15 to April 1, and cotton from April 1 to May 15. Cowpeas are grown mainly with corn or as a field crop following oats. In the former case they are planted in the corn rows after June 1 or broadcasted at the last cultivation. Peanuts are planted the latter part of May or, where they follow oats, in June.

Fertilizers are used to some extent for corn and cotton. From 150 to 250 pounds per acre of a 10-1.65-2 or a 10-1.65-0 fertilizer, or 200 to 300 pounds of mixed cottonseed meal and acid phosphate is used. These applications increase yields about one-third on old fields low in fertility.

Farm land of the Bowie very fine sandy loam sells for \$20 to \$75 an acre, depending on the value of the improvements and the location with reference to markets and improved roads. Land in timber sells for \$15 to \$30 an acre.

The Bowie very fine sandy loam can be made more productive by growing such crops as cowpeas, peanuts, velvet beans, and crimson clover on a larger acreage. These crops should be arranged in a systematic rotation with the principal farm crops and an occasional crop of cowpeas or clover turned under to increase the supply of organic matter, which is low in all old fields, and rapidly depleted by the present farming system on new soils. A rotation of oats, followed by cowpeas, cotton, and corn with cowpeas is recommended for this soil. In addition, winter cover crops can be used to advantage for green manuring and also to supply limited winter grazing. Bermuda-grass pastures can be improved by disking and sowing Japan clover in the spring and redisking and sowing bur clover in the early fall. Some of the more poorly drained parts of the type will be greatly benefited by tiling.

The Bowie very fine sandy loam is well suited to the crops grown at present and those recommended above. It is well adapted to the diversified production desired on the small general-purpose farm, and will probably return the greatest net income where farmed in relatively small tracts (80 to 160 acres) under a system which includes a main cash crop, with sufficient live stock to consume the feed and forage.

Bowie very fine sandy loam, poorly drained phase.—The surface soil of the Bowie very fine sandy loam, poorly drained phase, is a gray very fine sandy loam passing into pale-yellow or mottled yellow and gray very fine sandy loam which is underlain at 8 to 12 inches by a yellow to mottled yellow and gray friable sandy clay subsoil. The surface soil is rather high in silt, and the lower subsoil is moderately compact, though not plastic. Dome-shaped mounds are numerous and prominent. The phase as mapped includes small areas of Lufkin very fine sandy loam and Susquehanna very fine sandy loam, deep phase.

The Bowie very fine sandy loam, poorly drained phase, occurs principally in a number of small areas in the vicinity of Texarkana, Maud, and De Kalb. It occupies rather flat areas around the heads of drainageways or on flat slopes and low-lying approaches to streams. The surface is very gently sloping or almost flat, except for

the billowy or hummocky relief due to the mounds. The internal drainage is poor, and the run-off is retarded by the flat surface and the presence of the mounds, so that water frequently stands on the surface after heavy rains.

The Bowie very fine sandy loam, poorly drained phase, is not very extensive. Probably one-third of it is in cultivation. Part of the remainder is in permanent pasture, but most of it supports a timber growth of shortleaf pine, post oak, and willow oak, with pine, red oak, and hickory on the mounds. Corn and cotton are the principal crops grown. Corn yields 10 to 25 bushels per acre and cotton from one-fourth to one-third bale. The type is handled much like the other upland soils, except that ditching is usually done and the crops are grown on high ridges.

When properly drained this soil is adapted to corn, cotton, sorghum, oats, and Bermuda grass and lespedeza for hay and pasture. It is well suited to a type of farming which includes stock raising in conjunction with the production of cotton. The type is profitably used in other sections for growing strawberries. It requires, in addition to thorough drainage, the plowing under of organic matter in the form of barnyard or green manures. The application of lime will be beneficial.

Bowie very fine sandy loam, heavy phase.—The surface soil of the Bowie very fine sandy loam, heavy phase, consists of 4 to 6 inches of dull-gray silty very fine sandy loam, passing into pale-yellow silt loam. The surface soil grades at 12 to 16 inches into the subsoil of yellow silty clay loam which becomes mottled with gray and red and assumes a mealy structure below 20 to 24 inches. Large dome-shaped mounds, consisting of Norfolk and Ruston very fine sand and deep Bowie and Norfolk very fine sandy loam, are very abundant. This phase occurs in several relatively small areas in the central part of the county near Malta, New Boston, and Hooks. It occupies depressed or flat positions or very slight slopes, forming a gradation type between the Bowie very fine sandy loam and adjoining silt loam or silty clay soils. The flat surface and the numerous large mounds retard the surface drainage.

Only about 15 per cent of this soil is cultivated, and this area is included largely in fields of Bowie very fine sandy loam. Corn and cotton are the chief crops. The farming methods and the yields are about the same as on the typical very fine sandy loam, but crops mature somewhat later. Part of the heavy phase is in permanent Bermuda grass and lespedeza pastures. Part is in forest, the growth consisting mainly of post oak in the flats between the mounds and of red oak, blackjack oak, and hickory on the mounds. The forested area affords some grazing.

The first requirement in using this soil for crop production is to improve the drainage conditions, after which the type will produce good yields of corn, cotton, grasses, and forage crops.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the typical Bowie very fine sandy loam :

Mechanical analyses of Bowie very 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> |
| 444892..... | Soil..... | 0.1 | 0.5 | 0.3 | 9.8 | 43.0 | 38.5 | 7.5 |
| 444893..... | Subsoil..... | .1 | .3 | .2 | 6.4 | 32.4 | 28.0 | 32.6 |
| 444894..... | Lower subsoil... | .5 | .5 | .5 | 7.6 | 32.4 | 27.8 | 31.2 |

RUSTON FINE SANDY LOAM.

The surface soil of the Ruston fine sandy loam is a brownish-gray loamy fine sand passing at 4 to 6 inches into a light-brown fine sandy loam, which is underlain at 12 to 18 inches by dull-red to reddish-yellow, friable sandy clay. Small rounded chert and quartz gravel occurs throughout the soil and subsoil of much of the type. The principal gravelly areas are shown on the soil map by symbol. In a few places the surface soil is a loamy sand, and the subsoil a friable sandy clay.

The Ruston fine sandy loam occurs in a number of relatively small areas in the central ridge belt. Rather important areas occur in the western part of the county, near Dalby Springs, in the central part of the county between the Texas & Pacific and St. Louis Southwestern Railways, north of Leary, and in the southeastern part north of Sulphur. The type occupies knolls, low hills, and slopes to stream bottoms, and both surface and internal drainage are good.

There are 8,000 acres of the typical Ruston fine sandy loam in the county, and probably two-thirds of this area is in cultivation, the remainder being forested with shortleaf pine, red oak, sweet gum, and hickory. In some places nearly all the timber is second-growth pine, which has been allowed to take possession of fields thrown out of cultivation.

The same crops are grown on this soil as on the Ruston very fine sandy loam. The yields are about the same or slightly lower, but crops reach maturity somewhat earlier. Farm land on this type is valued at \$15 to \$40 an acre.

Ruston fine sandy loam, deep phase.—The surface soil of the Ruston fine sandy loam, deep phase, is a brownish-gray, fine sand to loamy fine sand which passes at 6 to 8 inches into reddish-yellow or light-brown fine sand. The subsoil in many places becomes some-

what loamy in the lower part of the 3-foot section, and grades at 4 to 5 feet into dull-red or reddish-yellow, friable fine sandy clay.

The largest areas of this phase occur near Liberty Hill School and Beaver Dam School, but a large part of the phase is made up of smaller, scattered areas. It occurs on knolls, hilltops, and slopes to stream bottoms, and drainage is good or even excessive, the open, porous nature of the subsoil promoting free internal movement of moisture.

The phase, which has less than one-fourth the extent of the typical soil, is unimportant in the agriculture of the county. About three-fourths of it supports a growth of pine or pine mixed with oak and hickory. Corn and cotton are practically the only crops, with vegetables for home use. The yields of corn range from 8 to 25 bushels per acre and of cotton from one-fifth to one-half bale, depending on the length of time the fields have been in cultivation and the seasonal conditions. The soil requires considerable rainfall for the best returns and yields usually average rather low after the land has been in cultivation for a few years. With heavy fertilization the production of early truck and melons would be profitable on those areas convenient to shipping points.

RUSTON VERY FINE SANDY LOAM.

The typical Ruston very fine sandy loam consists of brownish-gray loamy very fine sand to very fine sandy loam, passing at 4 to 8 inches into light-brown to light-reddish loamy very fine sand to very fine sandy loam, which extends to a depth of 12 to 18 inches. This grades into a subsoil of dull-red, reddish-yellow, or yellowish-red moderately friable to friable very fine sandy clay. The subsoil gradually becomes heavier and mottled with bright red and yellow as the depth increases, and the lower part of the 3-foot section consists of a compact to moderately plastic, mottled reddish and yellowish very fine sandy clay. Dome-shaped mounds are of common occurrence, and in some places they are so numerous as to give the surface a decidedly billowy character. They are in general, however, not as plentiful or as prominent as on the Bowie very fine sandy loam. On the mounds the soil consists of deep Ruston very fine sandy loam or Ruston very fine sand. Small brownish and dark-colored ferruginous concretions are often present on and in the material forming the mounds.

Small, rounded chert and quartz gravel is of common occurrence over the surface and through the entire 3-foot section. In some small areas as much as 75 to 80 per cent of the soil mass is composed of gravel. The more important gravelly areas are shown on the soil map by symbol.

The Ruston very fine sandy loam occurs mainly in a large number of relatively small areas. The type is most extensive in the eastern and southeastern parts of the county, in the vicinity of Texarkana, Nash, Leary, Redwater, and Maud. It is also extensively developed in the western part of the county south of De Kalb and in the northern part along Mud and Holly Creeks. In the central-ridge belt the type occupies slopes, low, swell-like ridges, and knolls, while in the flat belt it occurs on the slopes to drainage ways. In general it lies higher than the Bowie very fine sandy loam, but the boundary between these two types is seldom sharply defined and in places they occur in areas so intermingled that it is difficult to determine which should be mapped as the predominating type. The undulating to gently rolling surface insures good surface drainage, while the friable sandy clay subsoil absorbs and holds water well.

The Ruston very fine sandy loam is an important type agriculturally. It is very completely used for crop production, only about 10 to 15 per cent being in forest. The original tree growth consisted of shortleaf pine, red oak, sweet gum, and hickory. Corn and cotton are the principal crops, with oats, sorghum, cowpeas, and peanuts of lesser importance. Sweet potatoes, white potatoes, vegetables, strawberries, and peaches are grown for home use and to some extent for local marketing and shipment. Yields of corn range from 10 to 45 bushels per acre, and of cotton from one-fourth to three-fourths bale. Oats and sorghum give moderately heavy yields of forage. Cowpeas and peanuts do especially well. The Ruston very fine sandy loam is somewhat better suited to potatoes, vegetables, and peaches than the Bowie very fine sandy loam. The methods of farming are about the same as on the latter soil.

The Ruston very fine sandy loam seldom makes up an entire farm, but farms consisting largely of this soil are valued at \$25 to \$100 an acre, depending on the location with reference to towns and improved roads.

The methods of improvement suggested for the Bowie very fine sandy loam apply to this type as well. In addition, the more pronounced slopes require terracing and contour cultivation to minimize washing and more serious erosion.

Ruston very fine sandy loam, deep phase.—The surface soil of the Ruston very fine sandy loam, deep phase, is a brownish-gray very fine sand, underlain at 6 to 8 inches by yellowish very fine sand, which passes at 30 inches into reddish-yellow loamy very fine sand. The phase is underlain at more than 3 feet by reddish-yellow very fine sandy clay. It occupies flat slopes, knolls, and places where the dome-shaped mounds are so numerous as to coalesce in many places. The phase occurs only in a few small areas in the central-ridge belt. The same crops are grown as on the Ruston fine sandy loam, with

about the same yields. The original forest growth consisted of red oak, blackjack oak, and hickory, with pine in places.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Ruston very fine sandy loam :

Mechanical analyses of Ruston very 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> |
| 444833..... | Soil..... | 0.2 | 0.2 | 0.3 | 30.6 | 50.8 | 14.4 | 3. |
| 444834..... | Subsoil..... | .0 | .0 | .0 | 14.4 | 39.1 | 13.6 | 33.0 |

ORANGEBURG FINE SANDY LOAM.

The Orangeburg fine sandy loam has a surface soil of gray fine sand to loamy fine sand passing into brownish or reddish fine sandy loam. This is underlain at 12 to 16 inches by red, rather compact fine sandy clay which grades downward into red fine sandy loam mottled with yellowish colors. Chert and quartz gravel occurs on the surface and through the surface soil of parts of the type. Locally the surface soil is a medium to coarse sandy loam underlain by red sandy clay.

This type is rather inextensive. It occurs in a number of relatively small areas in the east-central part of the county, occupying knolls, hilltops, and slopes to stream bottoms. The surface is gently rolling, but with sufficient slope in places to cause rather serious erosion when the land is in cultivation.

About three-fourths of the area of this soil is used for crop production. About the same crops are grown as on the very fine sandy loam, and similar farming methods are followed. Crops reach maturity a little earlier than on the heavier soil, but the average yields under similar conditions are slightly lower.

ORANGEBURG VERY FINE SANDY LOAM.

The surface soil of the Orangeburg very fine sandy loam consists of brownish-gray loamy very fine sand to gray very fine sand, passing at 4 to 6 inches into pale-yellow to light-brown or reddish very fine sandy loam, underlain at 10 to 14 inches by deep-red, moderately friable very fine sandy clay, which becomes sandier and more friable with depth and is slightly mottled with yellow in the lower part of the 3-foot section. In places the surface soil contains a small amount of rounded chert and quartz gravel.

The Orangeburg very fine sandy loam occurs in several small areas in the eastern part of the county, near Eylau and to the north and

west of Nash. It occupies knolls, the tops of hills and ridges, and slopes to drainage ways. The surface is mainly gently rolling, but in many places the slopes are sufficiently abrupt to erode if cultivated.

Practically the entire type is under cultivation. Corn and cotton are the principal crops. Oats, cowpeas, peanuts, and sorghum are grown to some extent, and vegetables are produced for home use. Corn yields 15 to 35 bushels per acre, and cotton one-fourth to two-thirds bale per acre. The other crops make moderately good yields where the fields have not been too seriously eroded. Farm land on the Orangeburg very fine sandy loam is valued at \$25 to \$50 an acre.

This soil is suited to the crops grown at present and to such special crops as peaches, bush fruits, medium early truck, and tobacco. Much of the type is conveniently located with respect to shipping points. Production on this soil could be considerably increased by growing a larger acreage of legumes in a regular rotation with corn and cotton. Nearly all of the type is very low in organic matter, and green-manuring crops should be turned under where the supply of barnyard manure is small. Winter cover crops can also be made a source of organic matter if plowed under. Contour cultivation and terracing should be employed to control erosion.

Orangeburg very fine sandy loam, dark-colored phase.—The Orangeburg very fine sandy loam, dark-colored phase, has a surface soil of yellowish-brown to brown loamy very fine sand or light very fine sandy loam, passing into reddish-brown to light-reddish, heavy very fine sandy loam which extends to an average depth of 14 to 18 inches. This surface soil grades into a subsoil of reddish-brown or light-reddish, friable fine sandy clay. The dome-shaped mounds common to the other upland very fine sandy loams are either entirely lacking or very low and scattering. In parts of the type the sandy clay subsoil occurs as deep as 24 to 30 inches, while under the mounds it usually is not encountered above 36 inches. A few small areas in depressions consist of Lufkin and Caddo very fine sandy loam to silt loam.

The Orangeburg very fine sandy loam, dark-colored phase, occurs in several relatively small areas in the vicinity of Spring Hill School and about 3 miles north of New Boston. The surface is flat to slightly undulating, but owing to the permeable nature of the sandy clay subsoil the drainage is good, except in the depressions.

This phase is not extensive, but practically its entire area is devoted to crop production. Cotton and corn occupy a large part of the cultivated acreage and oats and sorghum the remainder. Cotton yields $\frac{1}{3}$ to 1 bale per acre, the larger yields being obtained in years of moderately heavy and opportune rainfall. The yields of corn average 25 bushels per acre, ranging from 15 to 40 bushels. Oats and sorghum give very good yields and are used principally as forage.

The farming methods are similar to those prevailing over the Ruston very fine sandy loam. Farm land on the phase is valued at \$15 to \$45 an acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Orangeburg very fine sandy loam :

Mechanical analyses of Orangeburg very 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> |
| 444831..... | Soil..... | 0.1 | 0.1 | 0.2 | 53.2 | 31.0 | 11.9 | 3.5 |
| 444832..... | Subsoil..... | .0 | .0 | .0 | 47.5 | 20.1 | 4.9 | 27.4 |

CROWLEY SILT LOAM.

The Crowley silt loam has a surface soil of dark brownish gray to brown silt loam, 8 to 12 inches deep, underlain by mottled gray and yellow or mottled gray, yellow, and rusty-brown silty clay loam, which passes quickly into mottled gray, yellow, and rusty-brown silty clay. This material changes abruptly at depths ranging from 14 to 26 inches into mottled red and bluish-gray, stiff, heavy clay. Small brownish and black concretions and small rounded quartz gravel occur through the surface soil and subsoil above the heavy clay. There are occasional mounds of deep Crowley silt loam, and on and near these the concretionary material and gravel are most abundant. In places there are numerous clay spots, a foot or two in diameter, separated by a few feet of silt loam. The surface material here is mottled red, brown, and dark drab, and grades below into mottled gray and yellow, plastic clay.

Near the drainage ways the soil and subsoil resemble the Lufkin series, in that the surface material is a mottled drab and rusty-brown silt loam to silty clay loam, underlain at 6 to 12 inches by mottled drab and yellow silty clay, which passes into drab or mottled drab, yellow, and rusty-brown, tough, heavy, impervious clay. This variation is most importantly developed in De Kalb Prairie, and along the drainage ways traversing the New Boston Prairie.

The Crowley silt loam is a prairie soil occurring in six fairly large areas in the central and western parts of the county. It supports a native growth of prairie grasses and a few clumps of scrubby blackjack and post oak where the mounds are numerous. Indigo and a broad-leaved plant, locally known as "wild collard," are common growths. The surface varies from nearly level to hummocky, where the mounds are abundant. The surface drainage is rather poor

as a result of the flattish surface, and the internal drainage is retarded by the impervious clay substratum.

Fully 75 per cent of this type is used for permanent pasture and the production of prairie hay. The remainder is in cultivation, with oats, peanuts, and sorghum as the principal crops. This soil is not considered adapted to corn and cotton or other crops requiring a long growing season, owing to its droughty nature. The grazing of cattle and sheep is an important industry on the Crowley silt loam. The permanent pastures are said to be improved by burning in the early spring and by seeding to lespedeza. Pasture land in good condition will carry 2 or 3 head of stock per acre during the grazing season. Prairie hay yields from 1 to 1½ tons per acre, in one cutting, which is made about July 1. Peanuts yield from 20 to 50 bushels per acre. Oats yield 25 to 45 bushels, or 2 to 3 tons of hay. Sorghum makes heavy yields of hay or forage, and some of the farmers use this crop for ensilage.

Labor-saving machinery is used on this soil to a greater extent than on any other type in the county. Plowing is done with two and three horse teams, with plows cutting a furrow slice 10 to 12 inches wide. Oats are generally seeded in February on land plowed in December and January. The crop matures about June 15, and is frequently followed by peanuts or cowpeas. Oats are seeded with a drill and harvested with a binder. Part of the crop is thrashed and the remainder is fed in the sheaf. The intertilled crops of peanuts and sorghum are grown on ridges and cultivated and hoed with the same implements that are used in the production of corn and cotton, except that just before the peanuts come up the ground is lightly harrowed. Peanuts are planted from May 15 to July 1. The local oil mills provide a market for the nuts, and the vines are used as stock feed. Very little of the crop is harvested by hogs on this soil.

The Crowley silt loam has been fertilized intermittently in the past. Cottonseed meal and acid phosphate have been used in acreage applications of 400 pounds for oats, and the effect has been noticeable in the following unfertilized crop of peanuts.

Farm land on this type is valued at \$10 to \$60 an acre, depending on the location and improvements.

In order to improve yields on this soil better drainage should be provided by means of shallow ditches. The crops should be arranged in a systematic rotation, which includes green-manuring crops, preferably legumes. Phosphatic fertilizers are beneficial for the small-grain crops. The depth of plowing on this soil should be gradually increased to 8 or 10 inches, and the seed bed for all crops should be more thoroughly prepared. The pasture lands can be greatly improved by seeding with white clover and lespedeza, and

clipping frequently during the growing season to eliminate obnoxious weeds. This soil has good agricultural possibilities. It is extensively used for the production of rice in Louisiana, southeastern Texas, and Arkansas, and where water is available for irrigation the possibilities of this crop should be investigated.

SUSQUEHANNA FINE SANDY LOAM.

The surface soil of the Susquehanna fine sandy loam consists of brownish-gray loamy fine sand, or brownish-gray loamy fine sand grading into yellowish or light-brown fine sandy loam. It passes rather abruptly, at 8 to 16 inches, into mottled red, yellow, and gray, or red, stiff, heavy clay, which becomes mottled with yellow and gray in the lower part. Some areas have gravel either on the surface or in the subsoil, or both, and are shown on the map by symbol.

This type occurs only in the central-ridge belt, and is most extensive between Hooks, Leary, and Redwater. It occupies knolls, ridge tops, and moderately abrupt slopes to drainage ways, and has good surface drainage.

About one-half of the type is cultivated, the remainder being forested with pine, blackjack oak, red oak, and hickory. The crops grown and the farming methods are similar to those on the other upland fine and very fine sandy loams. Yields are about the same as on the Susquehanna very fine sandy loam, but crops reach maturity somewhat earlier. This soil requires considerable rainfall for best yields, and is among the first to show the effects of drought. Farm land on this type sells for \$15 to \$35 an acre.

The methods of improvement suggested for the Susquehanna very fine sandy loam apply equally well to the fine sandy loam.

SUSQUEHANNA VERY FINE SANDY LOAM.

The surface soil of the Susquehanna very fine sandy loam is a brownish-gray loamy very fine sand or light-brown very fine sandy loam passing into pale-yellowish very fine sandy loam. Usually an inch or two of reddish, heavy, very fine sandy loam or clay loam intervenes between the surface soil and the subsoil, which is a red or mottled red and yellow, plastic, heavy clay. The subsoil continues as a plastic, heavy clay to a depth of over 3 feet, but it becomes increasingly mottled with gray with depth. Over the flatter portions of the type and in the vicinity of the deep phase and the Bowie very fine sandy loam the surface soil frequently grades into a subsoil of yellow, plastic clay which passes below into mottled yellow, red, and gray clay. Dome-shaped mounds are generally present on this soil, but they are not so high or so numerous as on the deep phase of the type. They consist mostly of deep Susquehanna, Ruston, and

Bowie very fine sandy loams. In the east-central part of the county chert and quartz gravel is associated with much of this type. Usually the gravel is found only on the surface and through the surface soil, but in places it is present in the subsoil as well or in the subsoil only. These gravelly areas are indicated on the soil map by symbol. On some slopes small areas or strips of Ruston or Bowie very fine sandy loam or Susquehanna clay loam are associated so closely with the Susquehanna very fine sandy loam that separation is impracticable in mapping.

The Susquehanna very fine sandy loam occurs extensively throughout the central ridge belt of the county and on parts of the flat belts. It occupies knolls, hilltops, slopes to drainage ways, and moderately flat to gently rolling uplands. The surface drainage is good, except on some of the flatter and more mound-covered areas, as south of Leary and Eylau, but the impervious, heavy clay subsoil prevents free internal drainage, causing a heavy run off which is attended by erosion on the more pronounced slopes where cultivated.

The Susquehanna very fine sandy loam is an important type agriculturally, as about two-thirds of it is in cultivation. The remainder is mainly in timber, principally red oak, white oak, blackjack oak, and hickory. In the eastern and southeastern parts of the county these trees are mixed with sweet gum and shortleaf pine.

Corn and cotton are the principal crops. Cowpeas, peanuts, oats, and sorghum are grown on a smaller acreage. Sweet potatoes and other vegetables are grown to some extent for home use and local marketing. Corn yields 15 to 40 bushels per acre, averaging about 25 bushels. Cotton yields one-fourth to one-half bale per acre, with an average of about one-third bale. Feed and forage crops give moderately heavy yields.

Commercial fertilizers are used to some extent on this soil for corn and cotton. Applications ranging from 150 to 300 pounds per acre are generally used, either a mixture of cottonseed meal and acid phosphate or mixtures analyzing 12-2-0 to 10-1.65-1. These applications are said to increase yields about 20 per cent.

The Susquehanna very fine sandy loam is handled in the same manner as the Ruston and Bowie very fine sandy loams, except that contour cultivation and terracing are employed by some of the better farmers to control erosion.

Farm land on this type sells for \$15 to \$75 an acre, depending on the location and improvements. From \$30 to \$35 is the prevailing price, except near Texarkana or other towns or in the more remote sections of the county.

The old cultivated fields on this type are low in organic matter, and green-manuring crops should be turned under. Yields can also be increased by growing legumes and winter cover crops more ex-

tensively in rotation with corn and cotton. The flatter areas of the type should be ditched. The Susquehanna very fine sandy loam is primarily a general-farming soil, well adapted to the crops grown at present.

Susquehanna very fine sandy loam, deep phase.—The surface soil of the deep phase of the Susquehanna very fine sandy loam consists of 4 to 6 inches of brownish-gray or mottled dull-gray and brown very fine sandy loam, grading into yellow or mottled yellow and gray very fine sandy loam which passes at 10 to 16 inches into yellow or mottled yellow and gray friable very fine sandy clay or silty clay loam. A substratum of heavy, plastic clay, mottled red and yellow, or red, yellow, and gray, or red and bluish gray, is encountered at depths ranging from 24 to 30 inches. The dome-shaped mounds are usually larger and more numerous than on the typical Susquehanna very fine sandy loam. They consist mainly of deep Caddo, Bowie, Ruston, and Susquehanna very fine sandy loam and Norfolk and Ruston very fine sand. In some of the large flat areas, as southeast of Redwater, and south of Simms, small areas of Caddo, Bowie, and Lufkin very fine sandy loam occur so intricately associated with this soil that separation is impossible in mapping.

The principal areas of Susquehanna very fine sandy loam, deep phase, occur east of De Kalb and in the locations mentioned above. The phase is widely distributed, however, in a large number of smaller areas throughout the central-ridge belt and the flat belts bordering this on the north and south. It occupies flat to slightly undulating areas on the broad divides and flat to depressed situations about the heads of drainage ways. The level surface and the numerous mounds are responsible for the very slow run-off, and the impervious clay substratum causes poor internal drainage. Water frequently stands in the intermound spaces for considerable periods during the rainy season and after heavy rains.

Probably not over one-fourth of this soil is under cultivation. A small part of the phase is cleared and in permanent pasture, but most of it is in timber, which is used to some extent for pasturage. The forest growth is mainly post oak, pin oak, and pine in the intermound spaces, with red oak, blackjack oak, white oak, sweet gum, and hickory on the mounds. Over much of the type in the central and western parts of the county there is no pine.

Corn and cotton are the only important crops on this soil. A small acreage is devoted to sorghum and ribbon cane for forage and sirup. The permanent pastures consist of Bermuda grass and lespedeza. Corn yields 15 to 40 bushels per acre and cotton from one-fourth to one-half bale. The soil is handled in the same way as the other upland very fine sandy loams, except that the crops are grown on

higher ridges and usually some provision is made to facilitate the surface drainage of cultivated areas.

Unimproved land of this type is valued at \$5 to \$15 an acre, and improved land at \$20 to \$35 an acre.

For general farming this soil should be improved by means of tile drains and ditches. When so improved it will be well suited to corn, cotton, forage crops, and grasses.

SUSQUEHANNA SILT LOAM.

The surface soil of the Susquehanna silt loam consists of 5 to 6 inches of light-brown silt loam overlying pale-yellow silt loam. The surface soil passes at 8 to 12 inches into yellow silty clay loam which grades downward into yellow or mottled yellow and reddish silty clay. This in turn is underlain at 15 to 20 inches by mottled red and yellow plastic, heavy clay becoming red, yellow, and bluish gray or drab mottled below. In forested areas the immediate surface layer is dark brownish gray to brown. Small iron concretions occur in the soil and upper subsoil. Chert and quartz gravel are found in the soil and subsoil over much of the type, the more gravelly areas being indicated on the soil map by symbol. Dome-shaped mounds are of general occurrence on the Susquehanna silt loam, but they are seldom high or numerous. They consist mainly of deep Bowie, Ruston, and Susquehanna very fine sandy loam.

The principal areas of Susquehanna silt loam occur in the central part of the county around the edge of the prairies, and southeast of Hooks. A large part of the type is made up of numerous small areas occurring near drainage ways in the flat belts to the north and south of the central ridge. The surface ranges from undulating to very gently rolling or gently sloping, with sufficient relief to provide good surface drainage. The type is rather extensive, but not very important agriculturally, as only about one-fourth of it is under cultivation. The remainder is forested with blackjack oak and post oak, with some red oak, white oak, and hickory. Most of the farmed area has been brought into cultivation during the last 5 or 10 years. The soil is not considered as well suited to cotton and corn as the upland very fine sandy loams, but these are the crops most extensively grown. It is considered well adapted to oats, peanuts, cowpeas, and forage crops, such as sorghum, and the acreage of these is steadily increasing. The yield of corn ranges from 10 to 30 bushels per acre and of cotton from one-fifth to one-half bale. Oats yield 20 to 40 bushels per acre and make heavy yields of hay when cut green. Peanuts yield 20 to 35 bushels per acre.

Improved land of this type sells for \$15 to \$50 an acre, depending on the location and the improvements. Land in timber sells for \$10 to \$30 an acre.

The Susquehanna silt loam requires heavier equipment than the very fine sandy loams. It should be plowed much deeper than at present, and the seed bed given more thorough preparation. The plowing under of green-manuring crops and occasional applications of lime are recommended. This soil is well suited to grains, grasses, forage crops, cowpeas, peanuts, and silage corn. Excellent pasturage can be provided by means of Bermuda grass and white and bur clover. With these sources of feed, forage, and grazing available this soil can doubtless be profitably used for the production of live stock.

Susquehanna silt loam, heavy phase.—The surface soil of the Susquehanna silt loam, heavy phase, consists of 6 to 8 inches of mottled dull-gray and rusty-brown, heavy silt loam, or silty clay loam. The subsoil begins as a mottled light-gray, yellow, and rusty-brown silty clay loam and grades at 12 to 20 inches into a mottled gray and yellow plastic silty clay. This is in turn underlain at 24 to 30 inches by a mottled red, yellow, and gray, or red and drab, heavy, plastic clay. Much of this phase is characterized by moderately numerous large mounds, consisting of Caddo, Bowie, and Susquehanna very fine sandy loam and Bowie and Susquehanna silt loam. In places the phase includes small areas of Lufkin silty clay loam (“pin-oak flats”), which it closely resembles in texture and drainage conditions.

The principal areas of Susquehanna silt loam, heavy phase, occur in the central part of the county, but it is also extensively developed in the flat belts bordering the central ridge. In the central ridge belt it occupies depressed positions or flat interstream areas, while in the flat belt it occurs along the edge of the flat interstream areas between the well-drained soil occupying the slopes and the more poorly drained Lufkin soils of the interior of the interstream areas. Owing to the flat surface the drainage is poor, and the impervious substratum causes slow internal drainage. Water often stands on the surface for some time after heavy rains, though not so long as on the Lufkin silty clay loam.

This is a rather extensive soil, but it is unimportant agriculturally. Probably not over 10 per cent of it is under cultivation, and this is confined largely to the better drained portions. The remainder of the phase is forested. In the intermound spaces the growth is almost wholly post oak, which has given rise to the local name of “post-oak flats.” In some places the intermound areas support a few shortleaf pine and where the phase is associated with patches of Lufkin silty clay loam there is some pin or willow oak as well. The mounds are forested with red oak, blackjack oak, and hickory, with or without pine. The forested areas are used for pasturage, the native grasses and lespedeza furnishing considerable grazing. The cultivated areas are devoted to corn and cotton.

Corn yields 15 to 30 bushels per acre and cotton from one-fourth to one-half bale.

Unimproved land of this phase is valued at \$5 to \$15 an acre and improved land somewhat higher.

With proper ditching this soil would be well suited to pasture grasses and forage crops in general and would give moderately good yields of cotton and corn. It is probably best suited to a system of farming in which the raising of live stock is the principal enterprise.

SUSQUEHANNA CLAY LOAM.

The Susquehanna clay loam is a brownish very fine sand or very fine sandy loam, from 1 to 5 inches deep, underlain by stiff red clay which grades below into mottled red and yellow plastic clay. This becomes mottled red and gray in the lower part of the 3-foot section. In places the subsoil is a bright-red, plastic, heavy clay to a depth of 3 feet. In some small included areas the surface covering is somewhat deeper than typical, approximating the Susquehanna very fine sandy loam, or has been entirely removed by erosion, giving the Susquehanna clay. The presence of gravel and fragments of ferruginous sandstone is indicated by symbol on the soil map.

This type occupies knolls, hilltops, and slopes to stream bottoms. It is most extensively developed along streams traversing the flat belts and along the margin of the uplands where they slope to the river bottoms. A number of small areas occur in the central ridge belt. The surface is sufficiently sloping to insure rapid run-off and to cause rather serious erosion in the cultivated areas.

About one-fourth of the type is used for the production of crops, principally corn, cotton, and oats. Yields average rather low, corn yielding 8 to 20 bushels per acre and cotton from one-fifth to one-third bale per acre. Oats do very well and are grown on an increasing acreage yearly. Much of the type has been cleared and is used for permanent pasture. This usually consists of fields that have been cultivated until erosion has become serious. About one-half of the type is forested with pine, red oak, blackjack oak, and hickory. This soil is best suited to grains, grasses, and forage crops.

LUFKIN SILT LOAM.

The Lufkin silt loam has a surface soil of gray silt loam or silty very fine sandy loam from 5 to 8 inches deep, underlain by gray or mottled gray, yellow, and rusty-brown silty clay loam. The surface soil is occasionally mottled with yellow and rusty brown. A substratum of tough, heavy, impervious clay, which frequently shows pockets or layers of white powdery silt and faint mottlings of yellow or yellow and rusty brown, is encountered at depths ranging from 14

to 24 inches. The surface material is ashy or light gray in color and compact when dry. The type includes some dome-shaped mounds of Norfolk very fine sand, a grayish very fine sand over pale-yellow or yellow very fine sand; of deep Caddo very fine sandy loam, which consists of grayish very fine sand passing into yellowish very fine sand and then into yellow or pale-yellow very fine sandy loam or very fine sandy clay mottled in the lower part with gray; or of Lufkin very fine sand, a gray very fine sand over compact, gray very fine sand or deep Lufkin very fine sandy loam.

The principal areas of Lufkin silt loam are found in the southwestern part of the county, in the vicinity of Dalby Springs, and southwest of De Kalb. A number of smaller areas are widely scattered throughout the south-central and eastern parts of the county. The type occupies broad, flat areas, or slightly depressed positions about the heads of drainage ways, and, owing to the flat surface and the impervious substratum, both surface run-off and internal drainage are poor. Water frequently stands on the surface for days after prolonged rains.

The Lufkin silt loam is a relatively inextensive type. Fully 95 per cent of it still supports a growth of willow oak, water oak, and post oak, with scattered shortleaf pine in places. A few of the areas are of a "glady" nature, and have but a sparse growth of timber. The cleared portion of the type is used for permanent pasture and for the production of corn, cotton, and forage crops. On most of the cultivated part of the type the drainage has been facilitated by means of ditches, and here crops give moderate yields.

LUFKIN SILTY CLAY LOAM.

The typical Lufkin silty clay loam has a surface soil of gray or mottled gray, yellow, and rusty-brown silt loam to silty clay loam, underlain at 5 to 8 inches by a subsoil of mottled gray and yellow, plastic silty clay which passes abruptly at about 18 to 24 inches into very tough, impervious, heavy clay of a bluish-gray or drab color, mottled faintly with yellow. Layers or pockets of ashy or powdery gray silt occur irregularly in the tough, heavy clay substratum. In typical areas the mounds are seldom numerous. Those that do occur consist mainly of Norfolk very fine sand and deep phases of the Lufkin or Bowie very fine sandy loam. The boundary between the Lufkin silty clay loam and the adjoining types is frequently indefinite. The type usually borders the Susquehanna soils, and as these are approached some red mottling is usually noticeable in the lower part of the 3-foot profile. Also, the mounds here often consist of deep Susquehanna silt loam and very fine sandy loam.

The area mapped north of De Kalb consists mainly of Lufkin silty clay loam, but it includes numerous small areas of Lufkin very

fine sandy loam, deep phase, and Susquehanna silt loam and silty clay loam, so intimately associated that separation is impossible. In general, the included types lie slightly higher and are somewhat more mound-covered and slightly better drained. Each soil also has its typical timber growth. In the south-central part of the county a few small patches of Lufkin clay are included with the type.

The Lufkin silty clay loam is developed in a number of fairly large areas within the flat belts which flank the central ridge on the north and south. A number of smaller areas are scattered throughout the central ridge belt. The type occupies flat or slightly depressed positions, without adequate drainage channels. Water frequently stands on the surface for days, and even after its disappearance the soil remains water-logged for some time.

This is one of the most extensive types in the county, but it is practically undeveloped. In most places it supports a growth of water oak and willow oak, with occasional post oak, and is locally known as "pin-oak flats." The growth on the mounds consists of red oak, post oak, blackjack oak, hickory, and shortleaf pine. A very small part of the type has been cleared and is used for permanent pasture, Bermuda grass and lespedeza making the principal growth. Probably not over 2 per cent of the type is used for crops. The cultivated areas are restricted to the margin of the type where the drainage is somewhat better, or to small areas from which the drainage waters can be readily removed by small ditches. Corn, cotton, and oats give moderately good yields in these places.

At present this land is valued chiefly for its forest. Cut-over areas are available at \$4 to \$10 an acre, depending on the location.

This type has produced much merchantable timber, railroad ties, and logs, and mills are still operating in sections where pine is associated with the hardwoods. The type if properly ditched would produce such crops as oats, grasses for permanent pasture and hay, and forage crops sufficiently well to make stock raising profitable. The organic matter content of the soil should be increased and lime applied in some form. The adaptation of rice to this soil should be investigated.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Lufkin silty clay loam:

Mechanical analyses of Lufkin silty clay 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> |
| 444853..... | Soil..... | 0.0 | 0.2 | 0.3 | 7.6 | 27.6 | 48.8 | 15.2 |
| 444854..... | Subsoil..... | .0 | .2 | .2 | 6.0 | 23.5 | 46.6 | 23.4 |
| 444855..... | Lower subsoil... | .1 | .1 | .2 | 5.2 | 20.6 | 47.0 | 27.0 |

LUFKIN CLAY.

The Lufkin clay has a surface soil of mottled drab and rusty-brown plastic clay, which passes at 4 to 6 inches into mottled gray and yellow plastic clay. The subsoil shows less conspicuous yellow mottling with increased depth and assumes a stiff, heavy, impervious structure. The surface is somewhat hummocky, with slight depressions, and the type is locally called "hog-wallow land."

The Lufkin clay is developed in the southwestern part of the county on the flat bordering the Sulphur River bottoms. It occupies flat or slightly depressed positions; and, owing to this and to the impervious nature of soil and subsoil, both the run-off and the internal drainage are slow and imperfect. Water frequently stands on the surface for days after prolonged rains.

This type is fairly extensive, but practically all of it remains forested. Much of the merchantable timber has been removed. The virgin growth consisted of willow oak, water oak, post oak, and short-leaf pine.

Less than 1 per cent of the Lufkin clay is used for crop production. The cultivated areas are largely confined to the margin of the type, where it slopes to other soils such as the Susquehanna clay loam, and where the drainage is somewhat better than typical. Oats do fairly well here, and corn and cotton give moderate yields. The selling value of this land is about the same as that of the Lufkin silty clay loam. It needs the same methods of improvement and is naturally adapted to about the same crops.

BASTROP CLAY.

The Bastrop clay has a surface soil of chocolate-brown to chocolate reddish brown clay, passing at 6 to 8 inches into chocolate-red clay. Both soil and subsoil are highly calcareous and contain numerous small lime concretions. The boundary with the Susquehanna clay is seldom distinct, and in places the Bastrop clay contains small patches or narrow strips of noncalcareous red Susquehanna clay.

The principal area of Bastrop clay occurs in the northwestern part of the county, about a mile north of Pine Spring School. Fairly important areas occur east of this place, along the margin of the Red River bottoms, northwest of New Boston along Mud Creek and Daniels Creek, and south of De Kalb along Anderson Creek. The type occupies well-drained, rolling slopes to the stream bottoms. Owing to the heavy texture, the run-off is relatively large and causes serious erosion on the steeper slopes.

The Bastrop clay is moderately extensive, and about one-half of the type is under cultivation. It is a prairie soil, locally known as

"red prairie," and much of the uncultivated portion is used for pasture. Fairly good grazing is furnished by the native prairie grasses and wild legumes. Bois d'arc, hawthorn, locust, and a few post-oak trees grow in places over the type, while included areas of the associated noncalcareous Susquehanna soils support a growth of red oak, post oak, and hickory.

Corn and cotton are the only important crops on the Bastrop clay. Corn yields 15 to 35 bushels per acre and cotton an average of one-third bale per acre. A small total area is in alfalfa, which yields an average of 4 tons an acre in four cuttings.

The productiveness of the Bastrop clay can be increased by means of deeper plowing, more thorough preparation of the seed bed, and the plowing under of organic matter. Terracing and contour cultivation are necessary on the more pronounced slopes to stop erosion. Intertilled crops, such as corn and cotton, should be grown in rotation with grains, grasses, and legumes. This soil is well suited to such crops as corn, cotton, grasses, grains, alfalfa, sweet clover, velvet beans, and peas. A system of farming which includes the raising of cattle and hogs in conjunction with cotton growing should be profitable.

Mechanical analyses of samples of the soil and subsoil of the Bastrop clay gave the following results:

Mechanical analyses of Bastrop 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> |
| 444862..... | Soil..... | 0.2 | 0.6 | 0.6 | 5.0 | 14.4 | 46.8 | 32.3 |
| 444863..... | Subsoil..... | .4 | 1.2 | .5 | 2.0 | 5.0 | 46.8 | 44.2 |

SUMTER CLAY.

The typical Sumter clay has a surface soil of brownish-gray to dull greenish yellow clay, which passes at about 5 inches into greenish-yellow plastic clay. The latter becomes mottled with white below 20 inches, and passes into white, chalky limestone or marl at depths ranging from 30 to 50 inches. The surface soil is usually calcareous, and the subsoil highly calcareous. The color of the surface soil and the depth at which the calcareous material occurs vary somewhat from place to place. Areas protected from erosion have a black surface soil (Houston clay), while in places where erosion has been severe the greenish-yellow subsoil has been exposed. In a few small patches the surface soil is reddish brown and noncalcareous, the type being a shallow phase of Oktibbeha clay.

The Sumter clay is mapped in the northwestern part of the county, about 1½ miles southeast of Pine Spring School and at several places

in the southern part of the county along the edge of the Sulphur River bottoms between Bassett and Maud. It occupies moderately abrupt slopes to stream bottoms, and the run-off during rains causes destructive erosion over much of the type.

This is a rather inextensive soil, and only about one-fourth of it is in cultivation. The remainder either is used for pasture or lies idle. The Sumter clay is a prairie soil, supporting only a scrubby growth of haw, cherry, and sumac in addition to the native prairie grasses and wild legumes. Corn and cotton are practically the only crops grown. The former yields 15 to 35 bushels per acre, and cotton one-third to three-fourths bale.

This soil needs to be protected from erosion by means of terraces and deeper plowing. The lighter colored (eroded) areas need more organic matter. The type is adapted to corn, cotton, grains, grasses, alfalfa, and sweet clover.

OKTIBBEHA CLAY LOAM.

The Oktibbeha clay loam has a surface layer of 2 to 4 inches of brown very fine sandy loam, which passes through 1 or 2 inches of brownish-red or red clay loam into the subsoil of plastic red clay. The latter changes to mottled red, yellow, and gray within a few inches. The red color decreases with depth until at about 18 to 24 inches the red mottling is lacking, and the gray and yellow give way to a greenish-yellow color. This lower subsoil material, which is noncalcareous, grades at slightly over 3 feet (40 to 50 inches) into mottled white and greenish-yellow, highly calcareous plastic clay or marl.

The Oktibbeha clay loam resembles the Susquehanna clay loam, except for the calcareous substratum. The type is subject to some variations. The sandy surface mantle in some places is lacking, while in others it may be 6 or 8 inches deep. Small patches are included where the soil has been so eroded as to expose the calcareous substratum, giving rise to small areas of black soils, the Houston clay and fine sandy loam, and to the Sumter clay, a dull greenish yellow soil. Fairly important areas are included in which the substratum consists of the red calcareous clay which produces the Bastrop clay on exposure and weathering.

The Oktibbeha clay loam occurs in widely separated places in the western half of the county, bordering the bottom lands of the Red and Sulphur Rivers and their principal tributaries. It occupies moderately abrupt slopes to the stream bottoms, and the surface drainage is very thorough. Internal drainage, however, is slow, and as a result the run-off seriously erodes the steeper cultivated slopes. This type is moderately extensive, but probably less than one-fifth of it is under cultivation. Much of the remainder

is in timber, but a small portion has been cleared for permanent pasturage. The timbered areas support a growth of post oak, black-jack oak, hickory, and hawthorn. Cotton is the principal crop grown. The yields range from one-fourth to one-third bale per acre.

The Oktibbeha clay loam requires terracing and contour cultivation on all the more pronounced slopes to prevent erosion. Old fields are very much in need of added organic matter, and deeper plowing and more thorough preparation of the seed bed would be beneficial. This is a moderately good cotton soil. It is best suited to oats, grasses such as Johnson grass and Bermuda grass, and lespedeza, and these crops, together with cowpeas, velvet beans, and corn, can be depended upon for pasturage and silage. The raising of hogs and cattle could well be made the main farm industry on this soil.

LEAF VERY FINE SANDY LOAM.

The surface soil of the Leaf very fine sandy loam is a light-brown to gray very fine sandy loam, 10 to 16 inches deep. The subsoil is a mottled gray and yellow very fine sandy clay, which passes at 18 to 30 inches into a plastic, impervious clay, mottled red, yellow, and drab. Large low mounds are numerous in places. They really represent a deep phase of the type. Between these mounds, in a few places, are patches of dark-colored very fine sandy loam or silt loam. Included with the type are small areas of brown Leaf silt loam, underlain by a mottled gray and yellow silty clay loam subsoil, which passes at 18 to 30 inches into an impervious clay mottled red, drab, or yellow. The Leaf silt loam is closely associated with the very fine sandy loam, but occupies flatter and more poorly drained areas. The Leaf very fine sandy loam also includes patches of gray Kalmia fine sandy loam, underlain by a pale-yellow, friable fine sandy clay subsoil. The Kalmia soil occupies high, well-drained areas.

The Leaf very fine sandy loam is developed on the second bottoms and terraces of the Sulphur River and its main tributaries. In the northwestern part of the county small areas occur along Mud Creek. The type occupies flat benches or terraces lying 5 to 30 feet above normal overflow. The numerous mounds give rise to a wavy or hummocky surface over a large part of the type. Surface drainage is rather slow, and the internal drainage is retarded by the impervious nature of the clay subsoil. The intermound areas are frequently wet for a considerable time after heavy rains. Most of the type can be drained by open ditches.

About one-half of this soil is under cultivation, the remainder being largely forested with red oak, hickory, shortleaf pine, willow

oak, post oak, and other hardwoods. Cotton and corn are the only crops of importance. Cotton yields from one-fourth to one-half bale per acre, and corn 10 to 25 bushels per acre.

This soil is handled in the same way as the upland sandy loams, except that the flatter areas need artificial drainage for best results. This soil is greatly benefited by plowing under green-manuring crops or barnyard manure. Deeper plowing and better preparation of the seed bed are also recommended. The soil is perhaps best suited to pasturage, as Bermuda grass and lespedeza do well.

MYATT SILTY CLAY LOAM.

The surface soil of the Myatt silty clay loam is a gray to drab silty clay loam or silty clay, mottled with yellowish brown or rusty brown, and about 6 to 10 inches deep. It is underlain by a mottled gray and yellowish-brown plastic silty clay which at 15 to 22 inches passes into a drab or mottled drab, yellow, and rusty-brown tough, heavy clay. This extends to about 3 feet, where it grades into a drab tough, heavy clay. The surface dries out to a light-gray or ashy-gray color. East of Macedonia School, and also east of Halls Store, the surface soil is a dark bluish gray or drab heavy clay evenly mottled with reddish brown and underlain by a bluish-gray waxy clay. The type includes areas of silt loam to very fine sandy loam having a mottled gray and yellow plastic silty clay subsoil. Dome-shaped mounds are scattered over the type.

The Myatt silty clay loam occurs on the terraces or second bottoms in the northern part of the county in the vicinity of Liberty Hill School and Halls Store, with one small area in the southwestern part about a mile east of Hoffman. The included patches of silt loam occur in the bottoms of Mud Creek and Red River. The type usually lies 5 to 15 feet higher than the adjacent first bottom. Its surface is prevaillingly flat, and the natural surface drainage is poor. The impervious subsoil also makes the internal drainage inadequate, and part of the type is in a semiswampy condition for considerable periods.

Practically none of this soil is under cultivation except a small area on the State Farm. The forest growth here consists largely of pin oak, water oak, cup oak, white oak, post oak, and willow, with some pine and hickory on the mounds.

With proper drainage the Myatt silty clay loam could be profitably used for grains and grasses. If water could be provided for irrigation, rice would probably be a profitable crop. Better drainage is essential; in many places open ditches will be adequate for this purpose.

A few small areas of prairie are included with the type. This soil is not materially different from the Myatt silty clay loam. It sup-

ports a growth of native prairie grasses, and is used as permanent pasture for cattle.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Myatt silty clay loam :

Mechanical analyses of Myatt silty clay 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> |
| 4448103..... | Soil..... | 0.1 | 0.4 | 0.5 | 14.0 | 27.0 | 32.3 | 25.7 |
| 4448104..... | Subsoil..... | .0 | .1 | .3 | 12.6 | 25.0 | 29.2 | 32.7 |
| 4448105..... | Lower subsoil... | .1 | .2 | .2 | 11.0 | 22.6 | 26.4 | 39.4 |

OCHLOCKONEE VERY FINE SANDY LOAM.

The Ochlockonee very fine sandy loam is rather variable in color and texture. In general it has a surface soil of brown very fine sandy loam, passing into a subsoil of light-brown to yellowish-brown heavy very fine sandy loam. A mottled gray and yellow fine sandy clay stratum may or may not be encountered within the lower part of the 3-foot section. The lower lying areas are frequently mottled drab and brown in the surface portion and have a mottled gray and yellow subsoil. In these places the surface soil and subsoil are often heavier than typical, approaching a silt loam in places. These areas and a few small areas of silty clay closely associated with the typical soil are included with it in mapping. In many places the type includes numerous mounds, which represent a light-textured phase of the type or approach in character the Kalmia very fine sand, which consists of brownish-gray loamy very fine sand underlain by pale-yellow very fine sand.

The Ochlockonee very fine sandy loam is widely distributed. It occurs as strips of first-bottom, overflow land along the minor streams receiving drainage from the sandy upland soils. The areas range in width from a few rods to one-half mile. The surface varies from nearly flat to hummocky, and between overflows the soil is fairly well drained.

This is a very productive soil, and for this reason alone fully three-fourths of its area is in cultivation. The uncultivated portion is partially in hay meadow and permanent pasture, but most of it still supports a growth of willow oak, water oak, sweet gum, ash, and holly, with hickory, red oak, and shortleaf pine on the mounds.

Corn and cotton are the chief crops grown. The growing of ribbon cane for the manufacture of sirup is engaged in largely on this type of soil. Oats, sorghum, and cowpeas are grown to some extent on

areas protected from overflow. Excellent permanent pasturage is provided by Bermuda grass and lespedeza, and the former is used alone as a hay crop. Both Sudan grass and alfalfa are being experimented with as hay crops.

The yields of corn on this soil range from 20 to 45 bushels per acre, and of cotton from one-third to three-fourths bale. Yields of most crops are somewhat uncertain without protection from damaging overflow. Oats, sorghum, and cowpeas are grown mainly for forage and give very good yields. From 75 to 150 gallons of sirup per acre is obtained from ribbon cane (sugar cane). Bermuda grass yields from two-thirds to 1 ton of hay per acre. Fertilizers are not used on this type of soil. Plowing is usually deferred until near seeding time, and the type is in general plowed moderately deep for inter-tilled crops, in order to throw up a high ridge to plant on. The same cultivation is given as on the upland very fine sandy loams.

For best results the Ochlockonee very fine sandy loam needs the straightening of stream channels, the construction of lateral ditches, and the building of dikes or levees to prevent overflows. The soil is well adapted to general farm crops and grasses.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Ochlochonee very fine sandy loam:

Mechanical analyses of Ochlockonee very 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> |
| 4448116..... | Soil..... | 0.0 | 0.1 | 0.1 | 10.2 | 51.3 | 32.3 | 5.5 |
| 4448117..... | Subsoil..... | .0 | .1 | .1 | 12.6 | 51.7 | 26.4 | 9.2 |
| 4448118..... | Lower subsoil... | .0 | .2 | .2 | 12.0 | 47.8 | 29.6 | 10.4 |

OCHLOCKONEE SILTY CLAY LOAM.

The typical Ochlockonee silty clay loam has a surface soil of brown silty clay loam, underlain at 6 to 12 inches by mottled yellow, gray, and rusty-brown silty clay, which passes at 20 to 26 inches into tough, heavy, drab or mottled drab and rusty-brown silty clay or clay. The texture of the surface soil ranges from silt loam to silty clay, with silty clay loam predominating. Usually the silt loam occurs near the stream channel and the heavier textures in the slight depressions. Northeast of Carbondale the type is largely a silty clay, while along the small streams issuing from the prairie areas it is prevailingly a silt loam. In the silty clay areas the surface soil is a mottled drab and rusty-brown silty clay, 4 to 6 inches deep, and the subsoil is a mottled gray and yellow silty clay passing at 12 to

18 inches into tough, heavy, drab clay. The silt loam areas pre-vaillingly consist of a brown, mellow silt loam passing at 10 to 16 inches into light-brown to yellowish silt loam or silty clay loam. The tough, heavy substratum may or may not appear within the 3-foot section.

The mounds common to much of the Ochlockonee very fine sandy loam occur only sparingly on this type, and over much of its area are entirely lacking. Those that do occur are rather low and consist of deep Ochlockonee very fine sandy loam and silt loam.

The Ochlockonee silty clay loam occurs in the first or overflow bottoms along the lower reaches of all the principal streams tributary to the Sulphur and Red Rivers, and many of the minor streams issuing from the silt loam and silty clay loam upland soils. The surface is prevaillingly flat, but some variation is produced by abandoned stream channels and by a slight rise adjacent to the present and abandoned stream channels. The entire type is subject to overflow by the streams along which it occurs, and a small part is subject to overflow by backwater from the Sulphur River during flood stages. The flood waters recede slowly, but between overflows the type is fairly well drained.

About one-fifth of the Ochlockonee silty clay loam is in Bermuda-grass pasture, and the remainder is almost completely in timber, consisting of red oak, white oak, post oak, elm, ash, locust, ironwood, swamp maple, hackberry, holly, and in places pine. Switch cane grows profusely. The merchantable timber is being removed in several places by small sawmills.

Corn is the principal crop grown. Where undamaged by overflows it yields from 20 to 45 bushels per acre. Cotton, the next crop in importance, is grown on a much smaller acreage. It yields one-third to three-fourths bale per acre. Hogs and cattle are grazed in the undeveloped portions of the bottom lands. The Ochlockonee silty clay loam is well suited to corn, forage crops, and grasses. With better drainage and the protection of crops from overflow, the raising of cattle and hogs would probably be successful.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Ochlockonee silty clay loam:

Mechanical analyses of Ochlockonee silty clay 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> |
| 444845..... | Soil..... | 0.0 | 1.4 | 0.9 | 3.5 | 10.3 | 60.5 | 23.4 |
| 444846..... | Subsoil..... | .0 | .0 | .9 | 36.3 | 34.4 | 22.2 | 6.4 |
| 444847..... | Lower subsoil... | .3 | 1.6 | .7 | 8.0 | 9.4 | 52.6 | 27.6 |

OCHLOCKONEE CLAY.

The Ochlockonee clay consists of a brown or mottled drab and brown clay, 3 to 8 inches deep, grading through a few inches of mottled light-drab and yellowish-brown, sticky, plastic clay into mottled gray and yellow material of the same texture and structure. A tough, heavy, gray or mottled gray and yellow clay is encountered at or below 24 inches. The immediate surface inch or so is dark brown to nearly black. This layer deepens over the western areas of the type as the Trinity clay is approached.

The Ochlockonee clay occurs in the first or overflow bottoms of the Sulphur River, from a point just south of Stover eastward to the southeastern corner of the county. Its surface is prevailingly flat, with little relief except for some abandoned stream channels.

The entire type is subject to heavy overflow by the Sulphur River, and none of it is under cultivation. The grazing of hogs and cattle is practically the only agricultural use made of this soil, and in its present condition it is valued principally for its timber, which consists mainly of large oak, gum, hackberry, and elm. Switch cane, which grows near the present and abandoned stream channels, furnishes some grazing. Lumbering for sawlogs and heading material is being carried on by the local sawmills.

This land at present sells for \$5 to \$20 an acre, depending on the location and the quantity and quality of the timber growth.

If the overflows could be prevented, this soil could be made to produce good yields of corn, forage crops, grasses, and probably cotton. Even without such protection it furnishes excellent grazing where cleared.

TRINITY CLAY.

The surface soil of the Trinity clay consists of 6 to 12 inches of black to very dark brown clay, plastic and sticky when wet but crumbly when dry. It passes into a subsoil of brownish-drab or mottled brown and drab, heavy, plastic clay, which becomes mottled with gray and yellow below. The surface soil in general is deeper in the western or upstream areas of the type and shallow in the eastern or downstream areas and near the outer edge of the bottoms adjacent to the upland. In places in the Sulphur River bottoms the dark-colored surface soil extends to a depth of 15 inches or over, and in these places the subsoil is correspondingly darker to a greater depth. Nowhere in the Sulphur River bottoms is the presence of lime indicated by effervescence with hydrochloric acid, but the dark color and crumbly structure characteristic of the Trinity clay are well developed, though less prominent as the Ochlockonee clay is approached. The line between these two soils is not sharply defined.

The area of Trinity clay mapped in the northwestern part of the county, about a mile southeast of Pine Spring School, consists of black clay, which extends to a depth of over 3 feet. This area has an abundance of lime in both the surface soil and subsoil. The area southeast of Pine Spring School is practically all in cultivation, yielding from 35 to 60 bushels of corn and from $\frac{1}{2}$ to 1 bale of cotton per acre. If protected from overflow, this area would be well suited to alfalfa.

With the exception of a few small fields in the vicinity of Darden and near the Red River County line the Trinity clay in the Sulphur River bottoms is uncultivated. The yields of corn on these few fields indicate that the soil is very productive and well suited to this crop. Development is retarded, however, by the heavy overflows from the Sulphur River, which frequently occur during the growing season and are slow to recede. With the exception of the few fields mentioned, the type is in timber, consisting of oak, elm, ash, hackberry, hickory, willow, and maple. Switch cane grows abundantly. Practically the only agricultural use made of this soil is the grazing of hogs and cattle in the forests. The type is valued principally for its timber, and is held at \$5 to \$20 an acre. When cleared this soil will produce good pasturage and heavy yields of hay in its present condition, and if protected from overflow it will be found suited to corn, cotton, oats, forage crops, and grasses, and also probably to alfalfa.

PLEDGER CLAY.

The typical Pledger clay has a surface soil of very dark brown to black clay passing at 10 to 16 inches into a subsoil of dark chocolate brown clay, and this at 24 to 30 inches into chocolate-red clay. The surface soil is sticky and plastic when wet, but crumbles on drying. In the lower lying situations the surface soil ranges from bluish black to mottled bluish drab and brown, and is underlain by a subsoil mottled with dark bluish, chocolate brown, yellow, and in places gray as well. This material is underlain at 30 to 48 inches by chocolate-red to chocolate-brown clay. In these lower situations the drainage is poorer than typical, water frequently standing on the surface for some time during the rainy season or after heavy rains. Such areas are indicated on the soil map by marsh symbols. The type also includes a few small areas, adjoining lighter textured soils, where the surface soil is a heavy clay loam.

Litmus tests indicate that the surface soil of the Pledger clay is slightly acid and deficient in lime, but the chocolate-red substratum shows effervescence with hydrochloric acid, indicating that lime is present in this part of the soil profile.

The Pledger clay occurs only in the Red River bottoms and in the lower part of the tributary bottoms which are flooded at times by back water from the Red River. It occupies the lower portion of the highest bench. There seem to have been two stages in the deposition of the sediments in the Red River bottoms, the Portland and Pledger soils representing the earlier sediments and the Miller and Yahola soils the later sediments. The Portland and Pledger soils occupy a bench 4 to 15 feet higher than that occupied by the Yahola and Miller soils. On the older of these benches the Portland soils occupy the higher portions, fronting on the drop to the lower and newer bench. There is a very gradual slope away from the outer edge of the older bench toward the uplands, and the Pledger clay occupies the lower positions back from the Portland soils. This same topographic arrangement prevails over the newer and lower bench, but here the direction of the slope is less regular, owing to the various positions the river has occupied during its formation. Abandoned channels and oxbow loops have affected the direction of the slope in places, by reason of a heavier deposition of sediment along the outer or convex bank. On this newer bench the Miller clay and Yahola clay occupy the lowest positions, while the Miller and Yahola silt loams, silty clay loams, very fine sandy loams, and very fine sands occupy higher positions. The Pledger clay usually fronts on one of the Portland soils, which occupy a slightly higher position and have a very gradual slope toward the upland.

The heavy nature of the Pledger clay makes internal drainage slow, but the surface, although appearing nearly flat, slopes sufficiently to lead the surface waters to the lower, more poorly drained positions indicated on the soil map by marsh symbols, or to natural drainage outlets. The marshy areas are too wet for profitable cultivation during normal seasons without ditching.

The Pledger clay is second in extent among the Red River bottom soils. It ranks very important agriculturally, though only about one-half the type is devoted to crop production. The more poorly drained portion is mainly in timber, consisting of elm, ash, post oak, white oak, willow oak, water oak, hickory, hackberry, sweet gum, hawthorn, and bois d'arc. This is considered the best cotton soil in the county, and the proportion of the cultivated area devoted to this crop is larger than on any other soil. Corn is of some importance, and alfalfa and oats are grown in a small way on the best drained areas. Yields of cotton range from one-third to 1 bale per acre. Corn yields from 25 to 50 bushels, and alfalfa 3 to 4 tons. Oats cut green for hay yield about $1\frac{1}{2}$ tons per acre.

The Pledger clay produces a cotton plant of moderate size which fruits heavily and reaches maturity early. These qualities facilitate cultivation and picking, and greatly reduce boll-weevil damage as

compared to those soils on which cotton makes a heavy vegetative growth and matures late. Some of the fields on this soil have produced cotton steadily for the last 25 years without any appreciable reduction in yield aside from that attributed to the boll weevil.

Plowing on this soil is usually begun in February. Two-horse implements are used, and the plowing is done moderately deep in order to obtain a good ridge on which to plant. During the first time through a furrow is thrown from each side of the old ridge into the old middle. Later the remainder of the old ridge is plowed out with a "middle buster." The beds are harrowed down somewhat just before planting. Cotton is planted about April 10 to May 15, depending upon the weather and moisture conditions. Cultivation is done with light turning plows, sweeps, shovels, 1-horse cultivators, and hand hoes. Fertilizers are very seldom used on this soil, but cotton is occasionally alternated with corn in order to maintain the productiveness of the soil.

Improved land of the Pledger clay sells for \$50 to \$125 an acre, depending on the improvements and the location with reference to improved roads and markets.

It has been demonstrated by the most successful farmers that better yields are obtained by plowing the Pledger clay deeply early in the winter. Much of the present cultivated area would be improved by providing better drainage.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Pledger clay:

Mechanical analyses of Pledger 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> |
| 444880..... | Soil..... | 0.0 | 0.3 | 0.3 | 2.4 | 8.9 | 41.4 | 46.8 |
| 444881..... | Subsoil..... | .0 | .1 | .2 | 3.6 | 10.5 | 35.4 | 50.0 |
| 444882..... | Lower subsoil... | .0 | .4 | .5 | 6.0 | 27.2 | 31.7 | 34.4 |

PORTLAND VERY FINE SANDY LOAM.

The Portland very fine sandy loam is a brown to chocolate-brown very fine sandy loam, underlain at 8 to 20 inches by chocolate-red clay or compact very fine sandy clay. The subsoil and, in places, the surface soil are calcareous. The areas mapped along McKinney Bayou, about 1 mile north of Morris School, vary somewhat from the typical. Near the outer margin of these areas the surface soil is a brown, very fine sandy loam underlain by dark-brown clay, which passes through mottled yellowish-brown and dark bluish gray clay into chocolate-red clay, while near the bayou the surface soil is more

often a light-brownish very fine sand or loamy very fine sand, passing at about 6 inches into yellowish or slightly reddish very fine sand or loamy very fine sand and at 16 to 20 inches into chocolate-red clay.

The Portland very fine sandy loam occurs in a number of relatively small areas in the Red River bottoms along the banks of abandoned river channels or oxbows. It lies slightly higher than the Portland clay and silty clay loam and has sufficient slope for rather good drainage. The type is inundated only by abnormally high overflows, and is therefore favored for farmstead and building sites. It is practically all under cultivation, devoted to corn, cotton, and vegetable gardens. The native timber growth consists of red oak, white oak, willow oak, ash, hackberry, hickory, cottonwood, and pecan. Corn yields from 15 to 35 bushels per acre and cotton from one-third to one-half bale. Crops are handled in the same manner as on the Miller very fine sandy loam. This soil should be well suited to alfalfa.

Mechanical analyses of samples of the soil and subsoil of the Portland very fine sandy loam gave the following results:

Mechanical analyses of Portland very 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> |
| 444816..... | Soil..... | 0.0 | 0.1 | 0.2 | 9.7 | 48.3 | 32.4 | 9.1 |
| 444817..... | Subsoil..... | .0 | .0 | .1 | 19.2 | 37.8 | 27.5 | 15.2 |

PORTLAND SILTY CLAY LOAM.

The surface soil of the Portland silty clay loam is a brown to chocolate-brown silt loam to silty clay loam, underlain at 5 to 7 inches either by chocolate-brown clay grading below into chocolate-red clay, or by chocolate-brown silty clay loam grading through silty clay into chocolate-red clay at about 10 to 20 inches. Both the surface soil and the deep subsoil are calcareous. The type includes small patches over which there is a thin covering of chocolate-brown very fine sand or very fine sandy loam.

The Portland silty clay loam occurs in the Red River bottoms, occupying positions intermediate between the Portland clay and very fine sandy loam. Parts of the area northwest of Green Hill School are underlain at 30 inches or more by chocolate-red silt loam or heavy very fine sandy loam. Fairly important areas occur in the vicinity of Rosborough School, southeast of Runnels Ferry, on the State Farm, and south of Clear Lake Ferry.

The surface of the type appears nearly flat, and neither internal drainage nor run-off is adequate. Nearly all the type, however, is

cultivated, being devoted to corn and cotton. Corn yields from 20 to 45 bushels per acre, and cotton from one-third to one-half bale or more. The type is handled in the same manner as the Portland clay. Where provided with good drainage it is adapted to corn, cotton, grain, grasses, and alfalfa.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Portland silty clay loam:

Mechanical analyses of Portland silty clay 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> |
| 444820..... | Soil..... | 0.2 | 0.4 | 0.2 | 2.0 | 37.6 | 46.4 | 13.4 |
| 444821..... | Subsoil..... | .0 | .7 | .4 | 2.0 | 23.4 | 45.7 | 28.0 |
| 444822..... | Lower subsoil... | .0 | .5 | .3 | 1.6 | 16.3 | 47.4 | 34.0 |

PORTLAND CLAY.

The surface soil of the Portland clay, locally known as "chocolate land," consists of chocolate-brown clay, sticky and plastic when wet but granular when dry. It grades at 6 to 16 inches into chocolate-red clay, which continues to over 36 inches. The soil is well supplied with lime in both surface soil and subsoil.

In the lower and less perfectly drained situations the surface material is frequently mottled somewhat with rusty brown, drab, and bluish gray, the typical chocolate-red subsoil being encountered at depths ranging from 24 to 40 inches. These areas resemble the Pledger clay, but their color is prevailingly chocolate brown rather than black. Along the Red River County line and in the vicinity of Bielohs Mill a variation from the typical soil is included, consisting of chocolate-brown clay passing at 8 to 15 inches into dark-brown or nearly black clay, which is in turn underlain at 18 to 24 inches or more by chocolate-red clay.

The Portland clay is mapped on the higher bench of the Red River first bottoms and the first bottoms of the smaller streams receiving sediments principally from the Bastrop clay. The surface appears to be flat, but is in reality slightly sloping in the direction of the adjoining Pledger clay or the natural drainage ways. Both surface run-off and internal drainage are slow, but adequate for crop production. The type is overflowed occasionally by very high rises of the Red River.

This is the most extensive type in the Red River bottoms and a very important soil agriculturally. About 50 per cent of it is used for crop production. The remainder is mainly in forest, consisting

of elm, ash, red oak, white oak, pin or willow oak, bur oak, hackberry, hickory, ironwood, and prickly ash.

Corn and cotton are the principal crops on this soil, occupying about an equal acreage. Alfalfa, Johnson grass, and oats are grown in a small way. Cotton yields from one-third to three-fourths bale per acre and corn from 25 to 55 bushels. Alfalfa and oats do well where there is good surface drainage, the former yielding from 3 to 4 tons per acre. Johnson grass makes heavy yields of hay. This grass usually appears voluntarily in alfalfa after a few years. The Portland clay is considered slightly better than the Pledger clay for corn and second only to that type for cotton.

Improved areas of the Portland clay are valued at \$40 to \$100 an acre, depending on the improvements and the location with reference to good roads and markets.

The Portland clay is well adapted to the crops generally grown, but the methods suggested for improving the Pledger clay can be applied to it with equally good results. In addition, the supply of organic matter should be increased, or at least maintained, by green manuring.

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

Mechanical analyses of Portland 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> |
| 444827..... | Soil..... | 0.1 | 0.5 | 0.4 | 4.7 | 5.7 | 34.5 | 54.4 |
| 444828..... | Subsoil..... | .0 | .6 | .8 | 7.4 | 6.0 | 33.1 | 52.2 |

MILLER VERY FINE SAND.

The Miller very fine sand has a surface soil of chocolate-red very fine sand, frequently containing sufficient silt to have a slightly loamy texture. This material passes at 3 to 10 inches into a subsoil of lighter chocolate red, loose very fine sand. Both surface soil and subsoil are calcareous. The type includes patches of the heavier textured Yahola and Miller soils in slight depressions. Near present and abandoned channels of the Red River considerable areas are very loose and incoherent in structure and somewhat lighter in color in both surface soil and subsoil than typical.

The Miller very fine sand occurs only in the Red River bottoms. The largest areas are mapped on the inner side of the large bends of the river. The type fronts either on the areas of Riverwash or on present or abandoned channels of the Red River, and represents the coarser sediments deposited from overflow waters.

The surface of this type varies from nearly level to hummocky or wavy where the areas have been reworked by recent overflows. Good drainage is insured by the open, porous nature of the subsoil. The water-holding capacity is low, except on areas underlain at slightly over 3 feet by silt or clay.

The Miller very fine sand is fairly extensive along the Red River but not more than one-third of it is used for crop production. A small part of the type is in permanent pasture and hay land. The remainder is covered by a growth of cottonwood and willow ranging up to 3 feet in diameter. The timbered areas afford some grazing.

Crop production is largely confined to the older and more silty portions of the type. Corn and cotton are the principal crops. Corn yields from 10 to 25 bushels per acre and cotton from one-fourth to one-half bale. Bermuda grass and Johnson grass make excellent pasturage and hay crops. To maintain good yields it is essential that the cultivated crops be grown in rotation with legumes and other green-manuring crops. If protected from overflow alfalfa would give moderately good yields on the better areas of this soil.

MILLER VERY FINE SANDY LOAM.

The surface soil of the Miller very fine sandy loam is a light chocolate red to grayish-red loamy very fine sand to very fine sandy loam. It ranges from 10 to 24 inches in depth and is underlain by chocolate-red clay or silty clay loam to silty clay which grades into clay. Beds of sand are often encountered at depths greater than 36 inches. On the State Farm on the Red River a deep variation is found, the reddish-gray surface soil being 24 to 36 inches deep. The lack of uniformity in the depth and texture of the surface soil has been caused by the deposition of very fine sand and silt over the heavier soils of the Miller series during overflows. Both soil and subsoil are calcareous.

The Miller very fine sandy loam occurs in the Red River bottoms, occupying areas slightly higher than the heavy types of the Miller and Yahola series. The surface is nearly level to gently undulating, but drainage is fairly good, except in slight depressions scattered throughout the type. The Miller very fine sandy loam is subject to only occasional overflows.

The principal areas of this soil are found in the vicinity of Clear Lake, Rosborough School, and the State Farm. It is one of the less extensive of the Red River bottom soils, but 85 to 90 per cent of it is used for crops. The original timber growth consisted largely of oak, elm, ash, hackberry, cottonwood, sycamore, and bois d'arc. The cultivated portion is devoted largely to cotton, with corn and Johnson grass and Bermuda grass occupying the remainder. Cotton yields one-half to three fourths bale per acre, and corn 20 to 40

bushels. Yields depend on the depth of the surface soil, being smaller where the depth to the underlying heavy subsoil is greatest, and best where this material occurs at a depth of 10 to 18 inches. Bermuda grass and Johnson grass afford fine pasturage and yield 1 to 2 tons of hay per acre. A mixture of these grasses in permanent pastures will carry from $1\frac{1}{2}$ to 2 head of live stock per acre during the grazing season. They are, however, a great pest in cultivated fields.

Yields on this soil can be increased by following systematic crop rotations, which include legumes for soil improvement and green manuring. The lower-lying areas need better drainage. The soil is well suited to alfalfa and forage crops in addition to the crops grown at present.

MILLER CLAY.

The surface soil of the Miller clay is a dull chocolate red to red clay or silty clay loam, 5 to 8 inches deep. It is very sticky when wet, but hard and crumbly when dry. The subsoil is a chocolate-red or dark-red plastic clay or silty clay. Both soil and subsoil are calcareous, lime concretions being encountered in many places in the lower subsoil. In low situations the subsoil is frequently mottled with bluish gray. Thin lenses of silt occasionally occur in the subsoil, and beds of very fine sand underlie part of the type at depths of 4 to 8 feet.

This type occurs in the lower parts of the Red River bottoms. The surface is nearly level, but with a slight slope toward abandoned river channels and oxbows which occur throughout the type. Both the surface run-off and the internal drainage are poor. The type is subject to overflow, and water stands in the depressions for considerable periods after heavy rains or inundations.

The Miller clay is considered a very strong soil, and practically all of it is under cultivation. Corn, cotton, and forage crops are successfully grown. Corn ranges in yield from 20 to 60 bushels per acre, and cotton from one-half to 1 bale. The lint of the ordinary short-staple cotton grows longer on this soil than on the upland, and usually brings 1 to 2 cents a pound more.

Land of this type sells at \$20 to \$60 an acre, the higher prices prevailing where the drainage is best and where protection from overflow is afforded by levees.

The Miller clay is handled in practically the same way as the Portland clay, except that planting is frequently much later. Artificial drainage would be of great benefit to the lower lying areas. Further extensions of the levee system should be made to afford greater protection from overflows. It might be possible to drain off some of the standing water by means of holes bored through to the underlying sand. With good drainage alfalfa would doubtless do well on this type.

YAHOLA VERY FINE SANDY LOAM.

The surface soil of the Yahola very fine sandy loam is a chocolate-red to chocolate reddish brown very fine sandy loam, ranging in depth from 6 to 16 inches. It grades into a subsoil of chocolate-red to grayish-red very fine sand, which continues to a depth of 36 inches or more. Both surface soil and subsoil are calcareous.

This type is distinguished from the Miller very fine sandy loam by its sandy subsoil. In places the surface soil passes at 10 to 20 inches into chocolate-red clay or silty clay loam, which gives way at depths of less than 36 inches to reddish or salmon-colored very fine sand. In a few places the surface soil is a chocolate-red silt loam or silty clay loam, 2 to 6 inches deep, underlain by very fine sand. Plowing of the underlying sandy material mixes it with the heavier surface soil sufficiently to make the latter a very fine sandy loam.

The Yahola very fine sandy loam occurs only in the Red River bottoms, occupying positions slightly lower than the Miller very fine sand but higher than the Miller and Yahola silt loam, silty clay loam, and clay. It represents areas where very fine sandy loam has been deposited over a subsoil of Miller very fine sand. The surface varies from gently undulating to nearly level, but owing to the porous, open nature of the subsoil the drainage is good.

The Yahola very fine sandy loam is a rather extensive soil of the Red River bottoms. Probably one-third of the type is still in forest, which consists of hackberry, elm, sycamore, ash, hickory, pecan, and cottonwood. Much of the cleared land is in permanent pasture and hay. About half the total area of the type is devoted to corn and cotton. Fairly good yields are obtained in favorable seasons, but the type, on the whole, requires considerable rainfall, especially for corn, on account of the porous and leachy subsoil. In some areas where there is a heavy layer in the subsoil the type holds moisture quite well. Cotton yields about one-half to two-thirds bale per acre and corn 20 to 30 bushels in seasons of normal or heavy rainfall.

The permanent pastures and hay lands are in either Bermuda grass or mixed Bermuda grass and Johnson grass. From 1 to 3 tons of hay is obtained per acre, and the pastures will carry $1\frac{1}{2}$ to 2 head per acre during the grazing season. The heaviest yields of hay are obtained where the growth is mainly Johnson grass.

This land is valued at \$20 to \$40 an acre.

Yields on the Yahola very fine sandy loam can be maintained and in some instances increased by growing legumes in rotation with the cultivated crops and by plowing under a green-manuring crop occasionally to keep up the supply of organic matter. This soil will produce good yields of alfalfa.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Yahola very fine sandy loam :

Mechanical analyses of Yahola very 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> |
| 444825..... | Soil..... | 0.0 | 0.1 | 0.1 | 0.8 | 51.5 | 37.7 | 8.7 |
| 444826..... | Subsoil..... | .0 | .0 | .0 | 1.8 | 72.0 | 21.7 | 4.3 |

YAHOLA SILT LOAM.

The surface soil of the Yahola silt loam is chocolate-red silt loam, or in places silty clay loam, 4 to 10 inches deep. It grades into chocolate-red silty clay loam to clay, which is underlain at depths ranging from 15 to 30 inches by chocolate-red or salmon-colored very fine sand or very fine sandy loam. In places the clay subsoil is absent and the silt loam is underlain by very fine sand or by very fine sandy loam, which passes into very fine sand within the 3-foot section. Both soil and subsoil are calcareous.

The Yahola silt loam occurs in a number of small areas scattered through the lower (Miller-Yahola) bench of the Red River bottoms, in positions slightly above the Yahola clay and slightly lower than the Yahola very fine sandy loam. The surface varies from nearly level to slightly undulating or wavy. Much of the type is subject to heavy overflow, and a few of the areas occupy depressions in which water stands for some time after overflows. Aside from these areas the type has fairly good drainage.

About 75 per cent of the type is farmed. The remainder is in forest, consisting of hackberry, elm, ash, sycamore, cottonwood, and a heavy growth of switch cane. The type is quite productive, especially where the sandy substratum is deepest.

Cotton yields an average of one-half bale per acre, with yields of 1 bale in favorable seasons. Corn yields 30 to 60 bushels per acre. Bermuda grass grows splendidly, and alfalfa would succeed where provided with good drainage and protection from overflow.

YAHOLA CLAY.

The Yahola clay consists of chocolate-red to chocolate-brown clay, underlain usually at 8 to 15 inches by chocolate-red very fine sandy loam or very fine sand. The depth at which the underlying sand is encountered varies considerably, sometimes being as great as 24 inches. Where the overlying clay is shallowest the sandy subsoil frequently is interbedded with thin strata or lenses of silt loam and clay. Both soil and subsoil are calcareous.

The Yahola clay is found only in the Red River bottoms, where it occupies old lake beds or abandoned river channels and nearly level to slightly undulating areas at about the same elevation as the Miller clay but slightly lower than the Miller and Yahola very fine sandy loams.

Most of the type is subject to heavy overflows, but owing to the sandy nature of the subsoil the surface soil dries out soon after the overflows subside. The drainage of some areas could be much improved by ditching, especially those areas adjacent to intermittent lakes, which keep the sandy subsoil saturated for some time after overflows.

The Yahola clay is moderately extensive among the Red River bottom soils. About one-half of it is cropped, and the remainder is in timber, consisting of hackberry, ash, elm, sycamore, cottonwood, and willow. Corn is the principal crop, yielding from 35 to 60 bushels per acre. Cotton averages about one-half bale, with reported yields of 1 bale in favorable seasons. Crop production is confined largely to the better drained areas. Bermuda grass and Johnson grass make good yields of hay and afford excellent pasturage. Alfalfa can be successfully grown with good drainage and protection from overflows.

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

Mechanical analyses of Yahola 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> |
| 444823..... | Soil..... | 0.0 | 0.1 | 0.2 | 2.9 | 7.5 | 53.6 | 35.9 |
| 444824..... | Subsoil..... | .0 | .1 | .0 | 2.4 | 51.7 | 35.1 | 10.8 |

RIVERWASH.

The classification Riverwash includes strips and bars of very fine sand, very fine sandy loam, and clay, mostly of the Yahola series, along with some medium sandy areas, all lying below the level of the banks of the Red River but above normal low-water stage. This material is subject to frequent deep flooding and to change by sedimentation and cutting away at each rise in the river. The higher portions are covered with thickets of willow and young cottonwood. The type is of no value agriculturally.

SUMMARY.

Bowie County is situated in the extreme northeastern corner of Texas. The Red River forms the northern boundary and the Sulphur

River the southern. A low undulating to gently rolling ridge extends across the central part of the county from west to east, flanked on the north and south by a lower lying flat belt of varying width. These flanking belts are bordered by the low flat bottoms of the Red and Sulphur Rivers and traversed by tributaries of these rivers. The upland elevation ranges from about 250 to 450 feet above sea level. The Red River receives the drainage from the northern two-fifths of the county, while the remainder drains into the Sulphur River.

Bowie County in 1920 had a population of 39,472, of which 70.9 per cent is classed as rural. Boston is the county seat. Texarkana, situated on the east county line, is the largest city, with a population in 1920 of 19,737.

The Texas & Pacific Railway, the St. Louis Southwestern Railway, and the Kansas City Southern Railway provide direct means of transportation to outside markets, principally St. Louis, Dallas, and Fort Worth. Texarkana is the junction point of all the railroads serving the county.

Bowie County is well supplied with public roads, about 80 miles of which are surfaced with gravel. Road improvement is being extended yearly.

The climate is characterized by relatively mild winters and long, warm summers, and is favorable for a widely diversified agriculture. The average growing season is 231 days in length. The mean annual temperature is 64.4° F., and the mean annual precipitation 40.19 inches.

The census of 1910 reports 59.8 per cent of the area of the county in farms. The agriculture of the county centers around the production of corn and cotton. About 33 per cent of the improved land is devoted to corn and about 32 per cent to cotton. Oats, peanuts, cowpeas, and sorghum are assuming a more important position in recent years. Peanuts are grown for sale and forage, and the other crops mainly for forage. Sugar cane for sirup is a special crop of some importance. White potatoes, sweet potatoes, vegetables, strawberries, and peaches are grown for home consumption and to some extent for marketing. The grazing of cattle is an important part of the farm enterprise on the prairie soils. Hogs and dairy cattle are kept in small numbers on nearly all farms operated by owners.

The crops are grown under the methods prevailing over the cotton-producing States. Light equipment and work stock are used on most farms. In general the cultivation given during the growing season is very good, but the preparation of the seed bed and the preliminary operations are inadequate. The use of commercial fertilizers is increasing.

The average size of the farms is given by the 1910 census as 74.6 acres. About 42 per cent of the farms are operated by owners and 57 per cent by tenants. Farm land ranges in value from \$15 to \$125 an acre.

Bowie County lies within the Coastal Plain region. The upland soils have been derived from unconsolidated beds of noncalcareous sand, sandy clay, and heavy clay, and calcareous clays or marls. The alluvial soils represent sediments washed from the uplands and deposited from overflow waters. They include the first-bottom soils, or recent alluvium, and the second-bottom (terrace) soils, or old alluvium.

The Norfolk series is represented by the Norfolk fine sand. This is an inextensive type, used mainly for corn and cotton. It is well suited to the production of early truck crops.

The Bowie series is represented by the fine sandy loam and very fine sandy loam. The latter is the most extensive soil in the county, and the most valuable member of the series. It is used principally for general farm crops. The fine sandy loam is an extensive soil of considerable agricultural importance.

The Ruston series in this county includes the fine sandy loam and very fine sandy loam. These are both important soils, used mainly for general farm crops, but also for fruit and vegetables. They are among the best drained of the upland soils.

The Orangeburg soils are not very extensive. The very fine sandy loam is the principal type. It is practically all used for general farm crops. This soil, as well as the fine sandy loam, is naturally suited to peaches and tobacco.

The Crowley silt loam is a prairie soil, well suited to grains, grasses, forage crops, peanuts, and peas if provided with proper drainage and given thorough cultivation. It is used largely for prairie hay, pasture grasses, oats, and peanuts.

The Susquehanna series is represented by the fine sandy loam, very fine sandy loam, silt loam, and clay loam. The clay loam and fine sandy loam are not very extensive. The very fine sandy loam is an important agricultural type, used mainly for general farm crops. Its deep phase is rather extensive, but unimportant agriculturally because of the poor natural drainage. When properly drained it is suited to corn, cotton, grasses, and forage crops. The silt loam is being rapidly brought into cultivation, and devoted mainly to corn, cotton, oats, and peanuts.

The Lufkin series is represented by the silt loam, silty clay loam, and clay. These soils are all poorly drained. They are mainly in timber and little used for agriculture.

The Bastrop clay is rather inextensive. It is a strong soil, however, producing good yields of corn, cotton, grains, grasses, forage crops, and alfalfa under proper management.

The Sumter clay is of small extent. It is suited to corn, cotton, grasses, forage crops, and alfalfa.

The Oktibbeha clay loam is fairly extensive but little used for crop production. It is suited to grains, grasses, and forage crops.

The Leaf very fine sandy loam is a second-bottom soil utilized for practically all the staple crops.

The Myatt silty clay loam is a poorly drained second-bottom soil mainly in timber and not used for crop production.

The Ochlockonee series is represented by the very fine sandy loam, silty clay loam, and clay. These are first-bottom soils, subject to overflow. The very fine sandy loam is extensively used for corn, cotton, and ribbon cane. The silty clay loam is also an important soil, but the clay, while the most extensive type of the series, remains in timber, owing to the frequency of deep overflows.

The Trinity clay is rather an extensive first-bottom soil, composed of sediments washed mainly from the dark-colored prairie soils outside the county. It is not used for crop production except in a very limited way, owing to the heavy overflows. If protected from these it would be well suited to corn, cotton, grasses, and forage crops, and probably to alfalfa.

The Pledger clay is the characteristic black soil of the Red River bottoms. It is an important agricultural soil, extensively used for cotton.

The Portland soils are the typical chocolate-brown soils of the Red River bottoms. The clay is the principal type. It is a very important agricultural soil, extensively used for corn and cotton. The very fine sandy loam and silty clay loam are inextensive types, used mainly for corn and cotton and to a slight extent for alfalfa. If provided with proper drainage and protected from overflow all the Portland soils would produce good yields of alfalfa.

The Miller series includes the chocolate-red soils of the Red River bottoms, with heavy clay subsoils. The series is represented by the very fine sand, very fine sandy loam, and clay. The clay is the principal type. It is rather a corn soil, and is used to a lesser extent for cotton. The very fine sandy loam is inextensive, but it is quite completely utilized for corn and cotton or hay and pasture grasses. The very fine sand is of little agricultural importance.

The Yahola soils are the chocolate-red soils of the Red River bottoms, with light-textured subsoils. The series in this county includes the very fine sandy loam, silt loam, and clay. The very fine sandy

loam is the most extensive type. It is used to considerable extent in the production of corn, cotton, and hay and pasture grasses. The silt loam and clay are less extensive types used for the same crops. The Yahola soils, like the Miller, would produce good yields of alfalfa if protected from overflow and properly drained.

Riverwash represents material of variable texture subject to heavy and repeated overflows by the Red River. It has no agricultural value.



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