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# Soil Survey

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## Choctaw County Oklahoma

By

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and

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United States Department of Agriculture

and

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Oklahoma Agricultural Experiment Station



UNITED STATES DEPARTMENT OF AGRICULTURE  
BUREAU OF PLANT INDUSTRY

In cooperation with the  
Oklahoma Agricultural Experiment Station

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# SOIL SURVEY OF CHOCTAW COUNTY OKLAHOMA

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United States Department of Agriculture in cooperation with the Oklahoma Agricultural Experiment Station

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<sup>1</sup> The field work for this survey was done while the Division was a part of the Bureau of Chemistry and Soils.

## INTRODUCTION

The soil survey map and report of Choctaw County, Okla., are intended to convey information concerning the soils, crops, and agriculture of the county to a wide variety of readers.

Farmers, landowners, prospective purchasers, and tenants ordinarily are interested in some particular locality, farm, or field. They need to know what the soil is like on a certain piece of land, what crops are adapted, what yields may be expected, and what fertilization and other soil-management practices are needed for best results. Many people do not wish to read the entire soil survey report, and they need not do so in order to obtain much of the information essential to their purpose.

A person interested in a particular piece of land should first locate it on the colored map accompanying the report. Then, from the color and symbol, the soil may be identified in the legend on the margin of the map. By using the table of contents the reader can find the description of the soil type or types. Under each soil type heading is specific information about that particular soil. There is a description of the landscape, including the lay of the land, drainage, stoniness (if any), vegetation, and other external characteristics; and the internal or profile characteristics of the soil—its color, depth, texture, structure, and chemical or mineralogical composition. The description includes information about present land use, crops grown, and yields obtained, and statements concerning possible uses and present and recommended management.

By referring to the section on Productivity Ratings and Land Classification one may get an idea of how the soil types compare with one another as to productivity for the various crops and how well they are suited for the growing of crops or for other uses. Further ideas concerning land use and soil management can be obtained from the section dealing with those subjects.

For the person unfamiliar with the county or area, there is a general description of the area as a whole in the first part of the report. Geography, physiography, regional drainage, relief, vegetation, climate, population, transportation facilities, and markets are discussed. A brief summary at the end gives a condensed description of the area and important facts concerning the soils and agriculture.

The agricultural economist and the general student of agriculture will be interested in the sections on Agricultural History and Statistics, Productivity Ratings and Land Classification, and Recommendations for the Management of the Soils of Choctaw County.

Soil specialists, agronomists, experiment station and agricultural extension workers, and students of soils and crops will be interested in the more general discussion of soils in the section on Soils and Crops as well as in the soil type descriptions. They will also be interested in the sections on Productivity Ratings and Land Classification and Recommendations for the Management of the Soils of Choctaw County.

For the soil scientist, the section on Morphology and Genesis of Soils presents a brief technical discussion of the soils and of the soil-forming processes that have produced them.

## COUNTY SURVEYED

Choctaw County is in southeastern Oklahoma (fig. 1), bordering the State of Texas, from which it is separated by the Red River. Hugo, the county seat, is 60 miles west of the Arkansas State line and 155 miles southeast of Oklahoma City. The area of the county is 790 square miles, or 505,600 acres.

The county is in the extreme northern part of the Gulf Coastal Plain, a forested rolling sandy area with associated small prairies of heavy soils. The features of relief owe their characteristics largely to normal erosion incident to the development of the intricate drainage system of the Red River drainage basin in which the county lies, although a few high stony ridges and hills in the northeastern part of the county represent isolated outliers of the rough lands of the Ouachita province just north of the county.

The county, as a whole, consists of a high southeasterly sloping plain in which several deep and many shallow valleys have been cut by drainageways, leaving comparatively small areas having relatively smooth surfaces. The smoother areas comprise strips of recent alluvium in the valleys of the Red River, Kiamichi River, and Muddy



FIGURE 1.—Sketch map showing location of Choctaw County, Okla.

Boggy and Clear Boggy Creeks; strips on the east-west belt of isolated prairies extending through the central part of the county; and comparatively small local areas on divides between the major and minor drainageways in the different parts of the county. The rougher and more steeply sloping areas are on escarpments and along the larger valleys of local tributaries to the Red River. Such areas are more extensive in the eastern and western parts of the county, along sections of north-facing escarpments passing in an east-west direction through the south-central and north-central parts, and on the southerly outlying hills and ridges of the Ouachita province in the northeastern part.

The surface of most of the county is underlain by Cretaceous sandstones, limestones, and unconsolidated beds of sands, clays, and sandy clays. The sandstone hills of the northeastern part of the county are of Carboniferous sandstones. Some high old stream terraces are of Recent and possibly, in places, Quaternary age.<sup>2</sup>

<sup>2</sup> The geological data are taken from publications of the Oklahoma Geological Survey as follows:

GOULD, CHAS. N., and others. PRELIMINARY REPORT ON STRUCTURAL MATERIALS OF OKLAHOMA. Okla. Geol. Survey Bul. 5, 182 pp., illus. 1911.

HONESS, C. W. GEOLOGY OF THE SOUTHERN OUACHITA MOUNTAINS OF OKLAHOMA. Okla. Geol. Survey Bul. 32, pts. 1 and 2, 278 and 76 pp., illus. 1923.

\_\_\_\_\_. OIL AND GAS IN OKLAHOMA. [Atoka, Pushmataha, McCurtain, Bryan, and Choctaw Counties.] Okla. Geol. Survey Bul. 40, v. 3, pp. [83]-108, illus. 1930.

A belt of rolling sandy forested land crosses the southern part of the county from east to west and occupies approximately two-fifths of the total area. This consists chiefly of exposed beds of Woodbine sands of the Upper Cretaceous. On the southern side this gradually slopes downward, merging with the lower Quaternary and Recent terraces of the Red River Valley, although in places sections of steeply sloping escarpments extend to the lower benches. The northern border of this belt is characterized by low but distinct steeply to moderately sloping hilly north-facing escarpment slopes leading down to the prairies below. This sandy belt constitutes the interior limit of what are generally considered formations of the Gulf Coastal Plain. The surface has a generally undulating to rolling relief caused by the dissection of numerous local tributary streams of the Red River.

The prairie belt just north of this belt comprises formations of the Lower Cretaceous, largely Caddo, Bennington, and Goodland limestones with some clays and shales of the Kiamichi and Bokchito formations. This prairie belt occupies about one-fifth of the county and is a more or less continuous area several miles wide extending in a general east-west direction through the central part of the county. It is interrupted by areas of sandy soils where dissection by stream valleys has exposed unconsolidated sandy beds of the Trinity formations, which lie just beneath the limestone beds. Therefore, some prairie areas occur in isolated small bodies. The surface is undulating to rolling, as many small streams have carved valleys deeply into or through the rocks. On the northern edge of this belt outcropping limestone slopes generally face northward and merge with the lower beds of Trinity sands.

The Trinity sands, the basal formations of the Lower Cretaceous, occupy an east-west belt across the northern part of the county, which extends northward many miles outside the county to the hills of the Ouachita province. This is a very rolling and dissected forested sandy belt with many steep slopes and deep narrow valleys. The formations are chiefly deep soft sandy clay beds, and there is little sandstone in the upper part. This belt occupies approximately two-fifths of the county.

Most of the county is well drained, although some stream bottoms of the larger local streams are so low and flat and the soils are so heavy that they remain wet for long periods. The bottoms along the Red River, and in places along other streams, although overflowed occasionally, have sufficient natural drainage to allow successful cultivation. Most of the county is drained by tributaries of the Red River, the largest of which pass through in a general southeasterly direction. The principal tributary streams are the Kiamichi River and Muddy Boggy, Clear Boggy, Whitegrass, Gates, Long, and Bokchito Creeks. Large areas of soils are so steep and loose that normal erosion, even under the rather heavy forest growth, has been severe, and the soils in such places are rather thin.

The general elevation of the higher parts of the northern part of the county is about 650 feet above sea level, and in the southern part along the Red River it is a little less than 380 feet. The elevation is 466 feet at Hamden, 494 feet at Goodland, 466 feet at Grant, and 528 feet at Lenoir.<sup>3</sup>

<sup>3</sup> MARSHALL, R. B. RESULTS OF SPIRIT LEVELING IN OKLAHOMA, 1895 TO 1912, INCLUSIVE. U. S. Geol. Survey Bul. 564, 119 pp., illus. 1914.

The sandy plains are forested, chiefly with oaks and hickory. The principal oaks are post, red, and blackjack. There is also a considerable growth of pine in the northeastern part of the county. On the prairies the native grasses are largely coarse bunchgrasses, including species of *Andropogon*. Some species of grama grow, also some other grasses. Osage-orange (bois d'arc), elm, and oak trees grow on some areas of prairie lands, especially in the rougher sloping positions. The bottom lands support a growth of oak, hickory, ash, elm, and hackberry trees, and in some favorable locations native pecan trees grow well. Although much of the forest growth remains, many of the larger trees have been cut for timber and firewood.

In most parts of the county good water is obtainable in wells ranging from 10 to 40 feet in depth. The streams are sluggish in flow, and many do not have water in them at all times of the year.

The first settlement of the land now included in Choctaw County was in the vicinity of the army post established at Fort Towson in 1824. Within a few years another settlement was made about 20 miles southwest of that place in the locality of the present town of Grant. Prior to and following these settlements, which included some white people as well as Indians, roving bands of Indians were scattered throughout the region. A gradually increasing number of white settlers spread into some parts of the county, largely to farm or to raise livestock. According to local reports, farming became general in certain of the smoother parts after 1900. Following 1907, when statehood was acquired, a considerable influx of white people took place, and these acquired land from the Indian owners and engaged in farming. Most of the early settlers were from Texas, Arkansas, and Tennessee. Cotton and corn were the principal crops grown, and livestock was raised by these settlers. Within recent years a number of people from other States have settled in the county.

The whites and Indians have intermarried considerably since the first settlements in the county. Following the act of Congress in 1908 lifting many restrictions on homesteads, much of the land came into ownership and control of whites and of Indians of part-white descent.

Choctaw County was organized in 1907, with the county seat, Hugo, near the center. The population was 21,862 in 1910, 32,144 in 1920, 24,142 in 1930, and 28,358 in 1940. The rural population for these years, as reported by the census, was 17,280, 25,776, 18,870, and 22,449. In 1940, native white persons made up 77.8 percent of the population, Negroes 18.4 percent, Indians 3.7 percent, and foreign-born white persons 0.1 percent. The 1940 census reports 3,042 farms in the county on April 1, of which 2,413 were operated by white (including Mexican) and 629 by nonwhite operators. The rural population is well distributed but is less dense in the rougher areas, especially in the northeastern sections and in some of the remote river valleys. Hugo, the principal trading center, had a population of 5,909 in 1940. Fort Towson, Boswell, Soper, Grant, and Swink are small towns on railroads and are local trading centers and shipping points.

The county is served by two lines of the St. Louis-San Francisco Railway, one passing in a north-south direction and the other in an east-west direction through the central part. Closely paralleling these railroads are United States Highways Nos. 271 and 70, which are

paved or otherwise hard-surfaced throughout. Practically all other roads are graded and improved dirt roads that are passable except when very wet.

Rural free delivery of mail is maintained throughout many parts of the county. Schools and churches are situated in the towns and more thickly settled rural communities. A large Federal public school for Indians is located at Goodland.

In Hugo several industrial plants, including a creosote plant, a cotton compress, a peanut huller, and cotton gins, process agricultural products. Lumbering consists mainly of cutting timber for railroad ties, fence posts, and barrel staves.

## CLIMATE

Choctaw County has a warm-temperate, humid, continental climate. The summers are comparatively long and warm, with a mean temperature of 81.1° F. The winters are comparatively short and mild, although periods of subfreezing weather frequently occur. The mean winter temperature is 45.4°. Minimum temperatures of -3° and maximum temperatures of 109° have occurred, but normally the temperature is rarely below 20° in winter or above 105° in summer. The short cold periods during winter are locally called northers, as they are generally accompanied by strong northerly winds. Very little field work is done during these periods, but it can be done except during the more severe northers when the ground freezes to a depth of 2 or 3 inches. These cold periods are often accompanied by rain, sleet, or light snowfall and are so short that people generally do not go out any more than necessary, postponing outside work or recreation until warmer weather.

The average frost-free period extends from March 23 to November 8, a period of 230 days. Frost has occurred as early as October 9 and as late as April 17. The growing season is long enough to mature a wide variety of crops. Corn and other crops replanted late in the spring after overflows on bottom lands often mature before frost. Warm weather in late winter frequently produces early blooming of fruit trees and pecan trees, resulting in injury or loss of crops by late frosts. In general, only apricots and peaches are affected, but damage from frost does not happen often enough to discourage the growth of these fruits for home use.

The grazing season generally lasts from about April 15 to November 1, but dry weather frequently limits available pasturage during July and August. Improved pastures containing a mixture of clovers and Bermuda grass may be grazed throughout the year.

The mean annual precipitation is 42.55 inches, but it has ranged from 28.46 inches during the driest year on record to 66.57 inches during the wettest year. Rainfall is fairly well distributed throughout the year. April, May, and October are the wettest months. Winter rains are usually slow, steady, and general, but many summer rains come in the form of heavy brief local showers, some of which are so heavy and torrential as to cause serious erosion in cultivated fields. An average of only 2.7 inches of snow falls each year. Droughts occasionally cause damage to crops but are never the chief cause of crop failure. Wet weather during spring often delays planting on the more poorly

drained lands and bottoms. Local late frosts are likely to cause injury to fruit and early vegetables in low bottom lands and flat areas where air drainage is deficient.

The prevailing winds are from the south and southeast throughout the year, with an average velocity of about 9 miles an hour. The sun shines about 50 percent of the total possible time during winter, 55 percent during spring, 70 percent during summer, and slightly less than 70 percent during fall.<sup>4</sup>

Severe hailstorms occasionally cause serious damage to crops in small areas but not oftener than once in 10 years in any one locality. Destructive tornadoes are rare and as a rule damage only very narrow strips when they do occur.

Important climatic data, compiled from the records of the United States Weather Bureau station near Hugo, are given in table 1.

TABLE 1.—Normal monthly, seasonal, and annual temperature and precipitation at Hugo (near), Choctaw County, Okla.

[Elevation, 605 feet]

| Month          | Temperature |                  |                  | Precipitation |   |  |
|----------------|-------------|------------------|------------------|---------------|---|--|
|                | Mean        | Absolute maximum | Absolute minimum | Mean          | Total amount for the driest year (1917) | Total amount for the wettest year (1926) |
|                | °F.         | °F.              | °F.              | Inches        | Inches                                  | Inches                                   |
| December.....  | 45.1        | 80               | 9                | 3.05          | 0.12                                    | 4.88                                     |
| January.....   | 43.4        | 81               | -3               | 2.81          | 1.63                                    | 5.00                                     |
| February.....  | 47.6        | 86               | 8                | 2.48          | 1.86                                    | 1.75                                     |
| Winter.....    | 45.4        | 86               | -3               | 8.34          | 3.61                                    | 11.63                                    |
| March.....     | 54.2        | 95               | 17               | 3.47          | 2.82                                    | 5.30                                     |
| April.....     | 63.7        | 96               | 26               | 4.02          | 5.53                                    | 3.10                                     |
| May.....       | 70.7        | 98               | 37               | 5.98          | 2.30                                    | 5.90                                     |
| Spring.....    | 62.9        | 98               | 17               | 13.47         | 10.65                                   | 14.30                                    |
| June.....      | 78.7        | 105              | 41               | 4.28          | 2.46                                    | 4.68                                     |
| July.....      | 82.2        | 109              | 52               | 3.88          | 3.33                                    | 17.10                                    |
| August.....    | 82.3        | 108              | 55               | 2.93          | 2.86                                    | 8.93                                     |
| Summer.....    | 81.1        | 109              | 41               | 11.09         | 8.65                                    | 30.71                                    |
| September..... | 75.8        | 104              | 40               | 2.82          | 1.60                                    | 2.02                                     |
| October.....   | 65.0        | 97               | 19               | 4.00          | ( <sup>1</sup> )                        | 5.88                                     |
| November.....  | 54.5        | 87               | 20               | 2.83          | 3.95                                    | 2.03                                     |
| Fall.....      | 65.1        | 104              | 19               | 9.65          | 5.55                                    | 9.93                                     |
| Year.....      | 63.6        | 109              | -3               | 42.55         | 28.46                                   | 66.57                                    |

<sup>1</sup> Trace.

## AGRICULTURAL HISTORY AND STATISTICS

The first agriculture in Choctaw County was practiced by the Indians of the Choctaw Nation on their arrival from Georgia, Alabama, and Mississippi about 1833. Game was plentiful at first, and subsistence was easily obtained, therefore little attention was given to the production of crops, but small clearings, called "Tom Fuller patches," were made in the virgin forest or along the edge of the prairie land,

<sup>4</sup> KINCER, JOSEPH B. TEMPERATURE, SUNSHINE, AND WIND. U. S. Dept. Agr. Atlas of American Agriculture, Advance Sheets No. 7, pt. 2, Climate, sec. B, 34 pp., illus. 1928.

and corn was planted for their own use. A few large plantations, however, were owned and operated by wealthy Indians or those intermarried with whites, who brought slaves and equipment with them from their native States. Corn, cotton, and livestock were produced and raised by the plantation owners. Corn and cotton were shipped down the Red River, and the livestock, principally cattle and horses, were driven to an eastern market. Following the War between the States, particularly after the railroad was built in 1886, immigration of white people from Texas and Arkansas increased rapidly, wild game became less plentiful, and cultivated areas became larger and more numerous. Agricultural development received an impetus, and the system became more diversified. Oats, wheat, and vegetables were produced by both Indians and white men. Soon sawmills were established, and lumbering was an important occupation until about 1910, when the greater part of the supply of merchantable timber had been exhausted.

In 1902 permanent titles and possession of lands were given to the Indians, including those intermarried with whites. Although farm improvements were made by the more prosperous plantation owners before this time, many farmers moved to new locations as their fields became depleted of the natural fertility. Each Indian in the Choctaw Nation was allowed to file claim for his homestead on the land on which he lived. After the beginning of statehood, nearly all of the land was allotted, and many of the farms changed from resident to nonresident ownership. Although many of the croppers and tenants were Negroes, white tenancy dates from this period.

By 1940, according to the census, 62.9 percent of the total area of the county was in farms, an increase of 30.4 percent over 1910. During that period the farms also increased in size from 80.5 to 103.7 acres, and in number from 2,040 to 3,042. In 1920, however, there were 3,781 farms, averaging 73.1 acres, in the county. In 1939, 118,162 acres, or about 23.5 percent of the area of the county, represented cropland. The average value of farm property (land and buildings) was reported as \$2,177 per farm in 1930 and \$1,293 in 1940. The average value per acre decreased from \$25.78 to \$12.47 during that period.

The census reports 33.5 percent of the farms operated by owners in 1910, 42.3 percent in 1920, 26.8 percent in 1930, and 35.9 percent in 1940. In 1910 tenants operated 66.4 percent of the farms; in 1920, 57.6 percent; in 1930, 73.1 percent; and in 1940, 63.8 percent. Managers operated 0.1 percent of the farms from 1910 to 1930 and 0.3 percent in 1940.

Most of the tenant farms are rented on a crop-share basis. Under this arrangement the owner furnishes the land and buildings, one-half of the fertilizer, work animals, seed, and equipment and receives one-half of the income derived from the crop; and the tenant supplies the labor.

The present-day agriculture consists mainly of the production of cotton, oats, barley, grain sorghums, alfalfa, and prairie hay, and the raising of cattle, hogs, and poultry. Most of it, however, centers around the production of cotton, as a cash crop, and corn. Table 2 gives the acreages of the principal crops, as reported by the census, and indicates the trend of agriculture during the last 30 years.

TABLE 2.—*Acreage of principal crops in Choctaw County, Okla., in stated years, as reported by the Federal census*

| Crop                                      | 1909         | 1919         | 1929         | 1939         |
|---|--------------|--------------|--------------|--------------|
|   | <i>Acres</i> | <i>Acres</i> | <i>Acres</i> | <i>Acres</i> |
| Corn.....                                 | 38,572       | 59,285       | 48,957       | 40,430       |
| Oats for grain.....                       | 1,194        | 8,237        | 1,888        | 3,275        |
| Oats, cut and fed unthreshed.....         |              |              | 1,862        | 1,092        |
| Wheat.....                                | 48           | 627          | 40           | 14           |
| Sorghums for grain.....                   | 8            | 7            | 150          | 958          |
| Dry peas (mainly cowpeas).....            | 135          | 125          | 672          | 5,839        |
| Peanuts.....                              | 112          | 996          | 2,683        | 4,278        |
| Cotton.....                               | 17,457       | 66,715       | 53,466       | 18,652       |
| Sorghums for silage, hay, and fodder..... |              | 12,530       | 1,418        | 5,674        |
| Alfalfa.....                              | 55           | 392          | 175          | 880          |
| Wild grasses.....                         | 4,952        | 6,119        | 1,529        | 2,720        |
| Legumes for hay.....                      |              | 476          | 578          | 1,901        |
| Grains cut for hay.....                   |              | 2,562        | 201          | 294          |
| All other hay.....                        |              | 83           | 804          | 4,567        |
| Sorghum cane.....                         |              | 397          | 153          | 181          |

<sup>1</sup> For forage only.

Soon after settlement of the county, cotton became the chief cash crop, but it did not exceed corn in acreage until after 1909. From 1909 to 1919 the acreage of cotton increased much more rapidly than that of corn. Since that time, however, a gradual decline has taken place in the acreages devoted to both crops, although the total acreage under cultivation has increased somewhat. In 1929 approximately 46 percent of the land harvested for crops (53,466 acres) was planted to cotton, and it yielded an average of 0.22 bale an acre, which was only slightly lower than the average yield of 0.24 bale obtained in 1909. In 1939, according to the census, only 18,652 acres were devoted to cotton, owing largely to the curtailment of production in connection with the cotton production control program, and the yield was about 0.38 bale an acre. Excessively droughty seasons and infestation by the boll weevil contribute chiefly toward differences in production from year to year in different parts of the county. Conditions during seasons of minimum precipitation are more favorable for cotton planted on the soils of the alluvial bottom lands than on soils of the uplands, as wet seasons encourage luxuriant growth and heavy foliage, the boll weevil is more active, and yields are greatly decreased. Some damage is also done to cotton on the heavy black soils of the uplands, but the production as a whole is greatly increased during a wet season. A season most favorable for a high average yield for the county is one having a large amount of rain during June and the early part of July and only a very small amount the remainder of the season. It is not uncommon for hot dry winds to damage cotton severely on the soils of the uplands.

The principal varieties of the longest staple cotton grown in the county are Rowden, Stoneville, and Delfos. These are grown mostly on the more productive soils of the first and second bottoms. When grown on soils producing a healthy normal growth of plants, they give a staple ranging from  $\frac{7}{8}$  to  $1\frac{1}{2}$  inches in length, which often brings a premium of 2 cents a pound. Oklahoma Triumph 44 cotton is grown mostly on the prairie lands, and Half-and-Half, although grown throughout the county, is grown largely on the poorer soils and in the sandy areas. On the sandier or poorer soils it is more largely the practice to grow cotton with a staple averaging about

$\frac{7}{8}$  of an inch in length. The Delfos and Stoneville varieties are reported as producing very little cotton on the poorer soils. Prices vary for the same variety according to the firmness of the cotton, which many believe is influenced by the natural productiveness and the management of the soil. The yield of long-staple cotton is generally lower than that of short-staple cotton, especially on the lighter textured soils. Some varieties of short-staple cotton are grown because the proportion of lint is often higher for the less valuable staple.

Corn ranks next to cotton as a source of revenue. It was the principal crop grown by the Indians and early settlers, and it surpassed any other crop in acreage until the period between 1909 and 1919. According to the census, the acreage in corn increased from 38,572 acres to 59,285 in 1919, then declined to 40,430 acres in 1939, and the average yields during this period ranged from 19.3 bushels an acre in 1919 to 14.0 bushels in 1939.

Although most of the corn produced is consumed locally, in parts of the county where the soils of the alluvial and prairie lands predominate, the greater part is marketed as a cash crop and shipped out of the county, despite the fact that many farmers on the prairie lands, as well as those on the sandy lands, do not produce sufficient corn for home use. On soils where corn is produced as a cash crop, yields range from 25 to 45 bushels an acre, but where the yields are below 25 bushels an acre it is grown as a subsistence crop. Although most of the corn matures the latter part of July in the bottom lands, particularly along the Red River, some of it is planted late and does not mature until about the middle of August.

Nearly all the corn produced, particularly on the more productive soils, is harvested from the row. Corn on some of the less productive soils is topped at maturity, and the tops are tied in bundles for winter feed, or the whole stalk is cut and placed in shocks.

The principal late-maturing varieties of corn are Reid Yellow Dent, Ferguson Yellow Dent, and Iowa Silvermine. Most of the corn produced on the uplands is of the dent varieties. Iowa Silvermine and some Bloody Butcher are grown on the soils of the alluvial lands. Varieties of corn maturing in 120 days or other short periods are Mexican June, Red June, and Surcropper. Nearly all of the varieties are tight husked, as this characteristic tends to reduce loss from attacks of weevils.

Very little grain sorghum was grown until about 10 years ago, and practically none was grown prior to that time. According to the census, the acreage devoted to grain sorghums has increased from 150 acres in 1929 to 958 acres in 1939. Most of the grain sorghums are grown on the light-textured or sandy soils. Only small patches of the alluvial soils, chiefly in the narrow first bottoms along the small creeks, are devoted to this crop. Although the average yield for the county is less than that of corn, in most years the yield on similar soils is from 5 to 10 bushels an acre more than that of corn. More grain sorghums than corn are grown on the less productive soils, and this accounts for a lower average yield. A large proportion of darso is grown, but most of the grain sorghums consist of hegari and kafir.

Some sorgo is grown for roughage, but this is an unimportant crop. Small acreages of sorgo and sugarcane are grown for sirup for home

use and the local market. The amount of sirup produced has greatly declined since 1900, but in some parts of the county, particularly on farms along the larger creeks north of Fort Towson, it remains an important source of revenue. Sugarcane is usually planted on the well-drained light-textured soils of the bottom lands and produces good yields of sirup of excellent quality. Sorgo is grown on the heavy-textured soils along streams issuing from the prairie lands. Some of the varieties of sorgo used for sirup are locally known as Tennessee Honey Drip, Japanese Honey Drip, Goldenrod, and Orange.

Cowpeas are desirable for adding nitrogen to the soil for the production of other crops. The census reports the acreage of cowpeas planted alone as increasing from 663 to 5,839 acres from 1929 to 1939, and the acreage planted with other crops from 300 to 1,081 acres. Until about 1934 they were grown almost entirely on the light-colored and light-textured soils, but recently the acreage on the lighter textured prairie soils has increased. It is a common practice to plant cowpeas with every two rows of corn, and some are planted in alternate rows with corn, in third or alternate rows with grain sorghums, or entirely alone. Cowpeas grown alone are harvested for hay or peas, but when grown with another crop they are usually used with the stalks as pasture after the other crop has been gathered.

According to the census, only a small acreage was planted to peanuts prior to 1919. The acreage increased from 112 acres in 1909 to 4,278 acres in 1939, which constituted a considerably greater increase for peanuts than for cowpeas during the same period. The acreage of cowpeas has increased more rapidly within the last few years. Nearly all of the peanuts are grown on the light-colored sandy soils. In harvesting this crop the vines with the peanuts attached are lifted from the loose soil and threshed and used as feed for livestock, or hay is made from the vines and hogs are turned into the fields to gather the peanuts left in the ground. Although peanuts add a large amount of nitrogen to the soil if allowed to remain in the ground and only the hay is harvested, most of the land on which this crop is grown is impoverished of plant nutrients, because both the foliage and the peanuts are harvested and removed from the land. In 1939, 1,125,026 pounds of peanuts were reported harvested on 510 farms in the county. A good market for peanuts has been established at Hugo.

Oats are grown by some farmers on the prairie lands. They are used for winter pasturage and, unless the season is unusually dry, are harvested for grain. A small acreage is sown on the light-colored sandy soils for pasture, but in most years approximately half of the acreage sown is harvested for grain. In 1939, 63,498 bushels were threshed from 3,275 acres, and oats were cut and fed unthreshed from 1,092 acres. The average acre yield of oats for the county is only about 18 bushels an acre, but local reports indicate that it is not uncommon for some of the soils of the prairie lands to yield as much as 50 bushels an acre.

The acreage sown to wheat never has been very large. In the last few years, however, a soft variety for winter pasturage has become more popular. In 1939, only 14 acres were reported in winter wheat, which was threshed and produced a total yield of 179 bushels.

In the bottom lands, particularly along the Red River, the acreage of alfalfa has greatly increased within the last few years. The average yield on these lands is about 3 tons an acre, and a yield of 6 tons an acre is not uncommon. A stand is usually maintained for 6 years before the land is reseeded or planted to another crop. Some farmers find that alfalfa can be produced profitably on some of the heavy soils of the prairie uplands. The yields, however, are not so high, and in most places it is necessary for the alfalfa to be reseeded every 3 or 4 years. Little attention is given by farmers to the varieties grown but, according to the county agent and seed dealers, Grimm, Common, and Argentine varieties are preferred.

Most farmers produce sufficient vegetables for their own use. A few special crops, such as potatoes, sweetpotatoes, watermelons, and cantaloups, are produced for local and outside markets. Vegetables are grown on a variety of soils, but well-drained fine sandy loams are recognized as best for the usual garden crops. According to the census, the value of farm garden vegetables, excluding potatoes and sweetpotatoes, was \$126,174 in 1939 and \$128,512 in 1929. The 284 acres planted in sweetpotatoes yielded 14,045 bushels in 1939.

Potatoes are the most important crop produced for the market. In 1929, 788 acres were planted to potatoes, and in 1939, 820 acres were planted and produced 54,643 bushels. Nearly all of this crop grown on a commercial scale is produced on the well-drained sandy soils along the Red River. Yields on these soils range from 100 to 250 bushels an acre. Most of the commercial fertilizers used in the county are for this crop.

Most of the sweetpotatoes are grown for local consumption. In 1934, 347 acres were planted, and a yield of 14,655 bushels was obtained. Although the sandy soils on the well-drained bottom lands return greater yields of sweetpotatoes, they produce well on the sandy soils of the upland.

Watermelons and cantaloups are produced mainly for home and local use, but in some years a large quantity is shipped from the county. Most of the melons are produced on the light-colored red sandy soils of the upland, but some are grown successfully on light-textured well-drained soils of the bottom lands and prairie lands. The chief varieties of watermelons are Mountain Sweet and Tom Watson. The Rocky Ford cantaloups are favorites, but some Osage cantaloups are grown.

Most of the fruit is grown for local consumption. Although the county offers opportunities for the development of fruit production, on no farms, according to the 1940 census, is fruit the principal source of income. Until the last 15 years most farmers maintained a well-established orchard containing several kinds of fruit, usually including peaches, pears, apples, grapes, plums, and bush fruits. Most of the orchards are now old and do not produce well, but a few home orchards are being started. Several types of sandy soils of the upland are particularly suited for the production of fruit, and most of the fruit is grown on these soils. In unfavorable seasons late frosts often damage many fruits, especially apricots, peaches, apples, and pears. The damage to fruit by late frosts and droughts has tended to discourage fruit growing. The fruit in a small area in the northeastern part of the county seems to be less damaged by late frosts, probably

owing to the retarded early seasonal growth at higher altitude and better air drainage on the rougher terrain. In 1939 fruits and nuts produced were valued at \$27,193.

Of the tree fruits, peaches are the most popular, and apples and pears are next in importance. The 1939 census reported 15,063 bearing peach trees, 2,222 bearing apple trees, and 2,193 bearing pear trees. Blackberries and dewberries are grown successfully in some parts of the county for home use and local markets. In 1939, 38 acres were reported. From 4,211 vines 10,055 pounds of grapes were harvested in 1939.

The native pecans in the bottom lands along the Red River and the larger creeks provide a source of income for the owners of land on which they grow. The native and paper-shell pecans produce well in most seasons in the better drained places in these bottom lands, and recently increased attention has been given to setting out and caring for paper-shell pecans. The 1939 census reported 5,836 producing pecan trees.

Wild grasses for hay were an important source of revenue on the prairie lands from 1900 to about 1925. Since that time more land has been placed under cultivation and the hay land has become less productive. The continual harvesting has prevented reseeding of the tall native grasses, and the less productive and less palatable wire grasses have replaced the bluestems. At present most of the hay harvested on the prairie land consists of Johnson grass. Although some of this grass has replaced the native grasses in the virgin meadows, most of it is harvested from meadows formerly under cultivation that have been sown to Johnson grass, or it has migrated from other fields and meadows. Most of the prairie hay is cut for local consumption, although some of the native-grass hay is hauled to outside markets. Johnson grass, if cut at the proper time, is considered by most farmers to be equivalent to or better than the native wild grasses. It is of somewhat less value for market, however, because of a State law that prevents its being shipped out of the county. According to the census, 2,571 tons of wild hay were cut from 2,720 acres in 1939.

Some poultry and eggs are produced on nearly every farm. The census reports 91,524 chickens and 1,327 turkeys on April 1, 1940. The number of turkeys raised has increased somewhat in the last few years, but the number of chickens remains approximately the same. Some farmers keep pure strains of Rhode Island Red, Barred Plymouth Rock, and Leghorn breeds, but most of the flocks are of mixed breeds. A few guineas, ducks, and geese are raised.

Cattle rank first among the livestock in number and value. The census reported 12,802 head of cattle on farms on April 1, 1930, and 21,152 head on April 1, 1939. Most of the cattle are raised for beef, but many are also used for dairy purposes. A few herds of dairy breeds are in the vicinity of Hugo, and most of the products from these herds are marketed locally. A few high-grade cows of the dairy breeds are on many farms. In general, the cattle raised for beef are of mixed inferior blood and low productive capacity, but there are a few good herds of grade Hereford cattle in the southwestern part of the county. Aside from a few purebred bulls in some of the large beef-cattle herds and a few purebred bulls of the dairy breeds, most of the bulls are of grade stock. Jersey is the most popular dairy breed.

Hogs are rather generally distributed over the county and are raised on nearly all farms operated by owners as well as on many of the tenant farms. They have been a source of income since early settlement of the county. The Federal census reported 12,041 hogs in 1930 and 11,799 in 1940. Although nearly every farmer raises a few hogs for his own use, most of those in the central part of the county or on the prairie land are raised for market. Because of a large area of hardwood forest that supplies a considerable quantity of mast, the hogs in most parts are allowed free range. It is customary, especially in parts of the county having sandy soils, to fatten hogs on peanuts and finish them on corn. Most of the larger corn producers, except on the prairie lands, raise hogs only for home consumption. Most of the hogs are of the Duroc-Jersey breed, although many are of mixed breeds, including crosses between Duroc-Jersey and Poland China.

The farm income derived from sheep and goats has never been important. The census reports 1,005 sheep and 625 goats in the county in 1940. This is an increase over the 196 sheep and 150 goats reported by the 1930 census. Most of the sheep are grade Shropshires, and the goats are Mexicans and grade Angoras.

In the early settlement of the county a large number of horses were raised on the prairie land and driven to markets in the East. Since 1920, however, the number of horses and mules raised has been insufficient to meet the local demand for draft animals, and a large number of mules have been shipped in each year. The Federal census reported 4,019 horses and 5,910 mules in 1930. These numbered 4,912 and 3,191, respectively, in 1940. Horses are used to some extent for draft purposes, but mainly for saddle and driving purposes. Very little effort has been made in breeding better draft types. It is reported that at present all the registered stallions in the county are of saddle or riding types. Most stallions used for breeding purposes are not purebreds, and many are of very inferior grade. Mules are the preferred work animals on the farm, but only a few are raised locally.

Table 3 gives the value of agricultural and livestock products in the county in stated years.

TABLE 3.—*Value of agricultural and livestock products, by classes, in Choctaw County, Okla., in stated years*

| Product                          | 1909       | 1919          | 1929        | 1939       |
|----------------------------------|------------|---------------|-------------|------------|
| Cereals.....                     | \$374, 228 | \$1, 747, 658 | \$550, 575  | \$377, 752 |
| Other grains and seeds.....      | 4, 629     | 55, 865       | 26, 393     | 52, 294    |
| Hay and forage.....              | 44, 168    | 213, 548      | 53, 808     | 146, 115   |
| Vegetables.....                  | 53, 645    | 423, 110      | 101, 087    | 185, 968   |
| Fruits and nuts.....             | 4, 789     | 130, 712      | 45, 325     | 27, 193    |
| All other field crops.....       | 362, 156   | 3, 741, 381   | 1, 204, 323 | 385, 624   |
| Animals sold or slaughtered..... | 232, 350   |               |             | 310, 270   |
| Dairy products sold.....         | 70, 214    | 45, 864       | 114, 092    | 91, 945    |
| Poultry and eggs produced.....   | 71, 078    | 309, 764      | 298, 285    | 129, 203   |
| Wool shorn.....                  | 16         | 235           | 78          | 1, 509     |

In 1909 only two farms reported the purchase of fertilizer, for a total of \$122, or an average of \$61 each. By 1939 the percentage had increased to 14.5, but the average amount expended per farm was only \$12.94 on the 440 farms reporting.

Most of the labor on farms is performed by the farmers and members of their families. The 1940 census reports 625 white farm la-

borers (wage workers) and farm foremen, of which 173 are non-white. This did not include, however 603 unpaid family workers, of which 101 are nonwhite. The census reports \$69,662 expended for labor in 1939 on 696 farms, or \$100.09 per farm reporting. The prevailing price for farm labor from 1931 to 1937 ranged from 75 cents to \$1.25 a day, and the price paid for picking cotton ranged from 50 to 75 cents a hundred pounds. Although there is little transient farm labor, it is plentiful throughout most of the year, except during cotton planting, chopping, and picking seasons.

Farm improvements, including houses, barns, and fences, vary considerably from place to place. Most of the farmhouses on the prairie land are, as a rule, substantial, and nearly all of the farmers in this area have barns which, although small, are large enough to house the work animals and store the crops. In other parts of the county most of the houses and barns are small and cheaply constructed and many of the barns are dilapidated. Many farmers in the bottom lands, particularly the small share-crop tenants, do not have barns. Most of the land in the large bottoms is not fenced. A large part of the sandy upland is fenced with wire, much of which is greatly depreciated. Osage-orange is used to some extent for fencing on the prairie lands, but most fences are of barbed wire, and they are generally very good. Most of the farm machinery is of one-draft type, consisting of planters, small turning plows, sweeps, and shovels, which are capable of efficiently cultivating the ordinary intertilled crops. The most up-to-date farm machinery is found on farms operated by owners, particularly those of the bottom lands along the Red River and the prairie lands. Most of the tractors and other large machinery are operated by landowners in the bottom lands along the Red River, although a few are in use on the prairie land.

## SOIL SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field.

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied. Each excavation exposes a series of distinct soil layers, or horizons, called, collectively, the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail, and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil<sup>5</sup> and its content of lime and salts are determined by simple tests.<sup>6</sup> Drainage, both internal and external, and other external features, such as relief, or lay of the land, are taken into consideration, and the interrelation of soils and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, special emphasis being given to those features influencing the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics the soils are

<sup>5</sup>The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality, higher values indicate alkalinity, and lower values indicate acidity.

<sup>6</sup>The total content of readily soluble salts is determined by the use of the electrolytic bridge. Phenolphthalein solution is used to detect a strong alkaline reaction.

grouped into mapping units. The three principal ones are (1) series, (2) type, and (3) phase. In places two or more of these principal units may be in such intimate or mixed pattern that they cannot be clearly shown separately on a map but must be mapped as (4) a complex. Areas of land, such as coastal beach or bare rocky mountain-sides that have no true soil, are called (5) miscellaneous land types.

The most important group is the series, which includes soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile, and developed from a particular type of parent material. Thus, the series includes soils having essentially the same color, structure, and other important internal characteristics and the same natural drainage conditions and range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The soil series are given names of places or geographic features near which they were first found. Thus, Bowie and San Saba are names of important soil series in this county.

Within a soil series are one or more soil types, defined according to the texture of the upper part of the soil. Thus, the class name of the soil texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Bowie fine sandy loam and Bowie very fine sandy loam are soil types within the Bowie series. Except for the texture of the surface soil, these soil types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific character it is usually the soil unit to which agronomic data are definitely related.

A phase of a soil type is a variation within the type, which differs from the type in some minor soil characteristic that may have practical significance. Differences in relief, stoniness, and the degree of accelerated erosion are frequently shown as phases. For example, within the normal range of relief for a soil type there may be areas that are adapted to the use of machinery and the growth of cultivated crops and others that are not. Even though there may be no important difference in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated crops. In such an instance the more sloping parts of the soil type may be segregated on the map as a sloping or hilly phase. Similarly, soils having differences in stoniness may be mapped as phases, even though these differences are not reflected in the character of the soil or in the growth of native plants.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, complexes, and miscellaneous land types, in relation to roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

## SOILS AND CROPS

The soils of Choctaw County may be classified in three very broad groups, in each of which the general characteristics and main features are somewhat similar. These are: (1) Light-colored sandy soils of the forested uplands and terraces, which are slightly acid and of low to moderate inherent fertility and make up more than half the total

area of the county; (2) dark-colored soils, which are moderately to highly productive where normally developed; and (3) soils of the bottom lands, which range from light to heavy and are, for the most part, inherently productive where well drained.

The light-colored sandy soils are largely in cultivation in small farms operated with little or no hired labor. These soils are generally leached and are low in both organic matter and plant nutrients, but on the smoother areas where farmed carefully and with good management, productivity is maintained and even increased. Farming operations consist chiefly of raising some livestock, such as cows and hogs, and producing cotton and feed crops, with vegetables and fruits in small gardens. The vegetables are produced mainly for home use. Yields of crops are not high, but farming is more diversified than on the heavy dark soils of the uplands and the alluvial soils of the stream bottoms. Where not carefully managed or protected, these soils, especially on the more sloping areas, are severely eroded, and much of the land has become too unproductive for profitable cultivation. These soils are especially suited to fruits, berries, and various truck crops, although they are not grown commercially. Good yields of such general farm crops as cotton, corn, and many feed crops are obtained where the land is carefully tilled and the organic-matter content is maintained. These soils respond to the use of manures and fertilizers.

The dark prairie soils are well suited to cotton, corn, and small grains, and they are very extensively used for these crops and for hay, both of native grasses and introduced forage crops. They are moderately to highly productive, and although some areas are thin and stony, the soils as a whole are used successfully. As a rule, the farms are larger and more improved machinery is used in carrying on farm operations than on the light-colored sandy soils.

The soils of the bottom lands are used where drainage conditions are favorable. Here, the principal crops are cotton, corn, and various other feed crops. The soils are, for the most part, highly productive and used to a considerable extent on the plantation system under one ownership but operated by tenants on small subdivisions of the land unit. Considerable areas of the alluvial soils along the Kiamichi River and Muddy Boggy Creek, as well as along other creeks, lie so flat and low that deficient drainage prevents successful cultivation.

For convenience in discussion, the soils of the county are arranged in groups, subgroups, series, types, and phases. The groups include soils with generally related characteristics, owing in large part to a general similarity in parent materials and other factors influencing development. In other words, the groups constitute a very broad inclusion of soils of the same general kind and approximately similar agricultural relationships. These groups are as follows: (1) Light-colored soils of the forested uplands, (2) light-colored soils of the forested terraces, (3) dark-colored soils of the upland prairies, (4) dark-colored soils of the forested terraces, (5) light-colored acid soils of the bottom lands, (6) dark-colored slightly acid soils of the bottom lands, (7) calcareous soils of the bottom lands, and (8) miscellaneous soils and land types unsuited to cultivation.

In the following pages the soils of the county are described and their

agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map;<sup>7</sup> and their acreage and proportionate extent are given in table 4.

TABLE 4.—*Acreage and proportionate extent of the soils mapped in Choctaw County, Okla.*

| Soil type                                  | Acres  | Per cent | Soil type  | Acres   | Per cent |
|--|--------|----------|--|---------|----------|
| Bowie very fine sandy loam.....            | 30,144 | 6.0      | Ochlockonee very fine sandy loam...              | 28,864  | 5.7      |
| Bowie fine sandy loam.....                 | 11,648 | 2.3      | Ochlockonee clay loam.....                       | 2,560   | .5       |
| Norfolk fine sandy loam.....               | 8,704  | 1.7      | Bibb very fine sandy loam.....                   | 1,344   | .3       |
| Norfolk fine sandy loam, deep phase.....   | 11,392 | 2.2      | Atkins silt loam.....                            | 1,280   | .3       |
| Norfolk loamy fine sand.....               | 10,688 | 2.1      | Atkins silt loam, high-bottom phase.....         | 1,472   | .3       |
| Ruston very fine sandy loam.....           | 7,808  | 1.5      | Atkins silty clay loam.....                      | 6,144   | 1.2      |
| Ruston fine sandy loam.....                | 15,232 | 3.0      | Pope fine sandy loam.....                        | 2,816   | .6       |
| Ruston loamy fine sand.....                | 2,944  | .6       | Pope loamy fine sand.....                        | 384     | .1       |
| Kirvin fine sandy loam.....                | 18,048 | 3.6      | Verdigris very fine sandy loam.....              | 5,888   | 1.2      |
| Kirvin fine sandy loam, rolling phase..... | 24,640 | 4.9      | Verdigris silty clay loam.....                   | 3,840   | .8       |
| Cuthbert fine sandy loam.....              | 41,792 | 8.3      | Pulaski loamy fine sand.....                     | 512     | .1       |
| Lufkin very fine sandy loam.....           | 8,640  | 1.7      | Kaufman clay.....                                | 20,416  | 4.0      |
| Sawyer very fine sandy loam.....           | 13,248 | 2.6      | Osage clay.....                                  | 8,576   | 1.7      |
| Boswell very fine sandy loam.....          | 15,232 | 3.0      | Miller clay.....                                 | 1,088   | .2       |
| Kalmia very fine sandy loam.....           | 8,512  | 1.7      | Miller silty clay loam.....                      | 1,280   | .3       |
| Kalmia fine sandy loam.....                | 5,632  | 1.1      | Miller very fine sandy loam.....                 | 384     | .1       |
| Kalmia fine sand.....                      | 3,776  | .7       | Roebuck clay.....                                | 2,624   | .5       |
| Cahaba very fine sandy loam.....           | 2,560  | .5       | Pledger clay.....                                | 1,856   | .4       |
| Myatt very fine sandy loam.....            | 5,376  | 1.1      | Yahola loamy very fine sand.....                 | 3,712   | .7       |
| Myatt silt loam.....                       | 7,040  | 1.4      | Yahola loamy fine sand.....                      | 1,152   | .2       |
| Myatt silty clay loam.....                 | 2,112  | .4       | Yahola very fine sandy loam.....                 | 3,840   | .8       |
| San Saba clay.....                         | 17,088 | 3.4      | Yahola silty clay loam.....                      | 1,280   | .3       |
| San Saba clay, shallow phase.....          | 3,520  | .7       | Yahola clay.....                                 | 960     | .2       |
| Denton clay.....                           | 5,248  | 1.0      | Denton stony clay.....                           | 21,440  | 4.2      |
| Denton clay, shallow phase.....            | 8,320  | 1.6      | Rough stony land (Denton soil material).....     | 10,752  | 2.1      |
| Newtonia very fine sandy loam.....         | 5,120  | 1.0      | Crawford stony loam.....                         | 4,864   | 1.0      |
| Newtonia silt loam.....                    | 4,928  | 1.0      | Cuthbert fine sandy loam, steep phase.....       | 6,976   | 1.4      |
| Durant silt loam.....                      | 17,984 | 3.5      | Pottsville stony fine sandy loam.....            | 1,216   | .2       |
| Durant silty clay loam.....                | 9,536  | 1.9      | Rough stony land (Pottsville soil material)..... | 3,840   | .8       |
| Durant-San Saba complex.....               | 1,728  | .3       | Susquehanna clay.....                            | 832     | .2       |
| Choctaw very fine sandy loam.....          | 8,128  | 1.6      | Cahaba fine sand, steep phase.....               | 1,600   | .3       |
| Crockett clay loam.....                    | 1,472  | .3       | Riverwash.....                                   | 1,024   | .2       |
| Teller very fine sandy loam.....           | 1,728  | .3       |  |         |          |
| Teller fine sandy loam.....                | 896    | .2       |  |         |          |
| Lonoke very fine sandy loam.....           | 2,816  | .6       |  |         |          |
| Lonoke silty clay loam.....                | 2,112  | .4       |  |         |          |
| Lonoke clay.....                           | 2,752  | .5       |  |         |          |
| Brewer silty clay loam.....                | 2,240  | .4       |  |         |          |
|  |        |          | Total.....                                       | 505,600 |          |

#### LIGHT-COLORED SOILS OF THE FORESTED UPLANDS

The light-colored soils of the forested uplands generally have gray or grayish-brown sandy surface soils underlain by sandy clay or clay subsoils. These soils have developed under a forest cover from sandy clay beds of the Upper and Lower Cretaceous formations (Woodbine and Trinity sands). The surface of these soils ranges from level to rolling. Most of the soils are low in content of organic matter and plant nutrients and are acid to slightly acid in reaction. The soils of this group are placed in two principal subgroups, namely, (1) soils with sandy permeable subsoils and (2) soils with heavy subsoils.

The soils of the first subgroup have more or less sandy and permeable subsoils but differ from one another in color, thickness, and other features. They include members of the Bowie, Norfolk, Ruston, Kirvin, and Cuthbert series. The land ranges from nearly level to rolling. The soils of the more nearly level areas are more productive,

<sup>7</sup> Areas of soils mapped along the western county line do not match areas of similar soils mapped in the previous survey of Bryan County in 1914. This difference is due to changes in classification and correlation of soils requiring greater detail in mapping than was employed at that time.

as a rule, than those on the sloping areas, and if carefully managed they produce moderate yields of many crops. In the more sloping areas the soils erode severely where unprotected. Probably 30 percent of these soils is in cultivation. Only a small quantity of fertilizer is used. Underdrainage is more free than in the soils of the next subgroup.

The soils with heavy subsoils are very similar in surface features and general characteristics to the soils with sandy permeable subsoils but differ from them in occupying generally smoother areas, in suffering less severe erosion, and in having denser and heavier subsoils, which cause deficient underdrainage. The same general kinds of forest trees grow, but in places where drainage is very poor these soils, in addition, support elm, Osage-orange, black oak, hackberry, willow oak, hawthorn, and honeylocust trees, together with post oak, hickory, and red oak trees. Some of the soils that have flat surfaces in addition to dense subsoils are too poorly drained for satisfactory cultivation. Some of them pack hard on drying and are not easily cultivated.

These soils are not extensively cultivated, owing to poor drainage in some soils and eroded rather thin soil layers in others. Probably not more than 15 percent of the area of the subgroup as a whole is used for cultivated crops. The soils included in this subgroup are members of the Lufkin, Sawyer, and Boswell series. The Lufkin soils may be considered representative of the members of the group that have very deficient surface drainage and the Boswell soils representative of those that have free surface drainage.

#### BOWIE SERIES

The Bowie series includes soils that have grayish-brown surface layers and subsurface layers of yellow friable material grading into yellow sandy friable clay subsoils with mottlings of yellow and some red splotches and streaks in the lower part. This material passes into beds of variously colored or mottled sandy clay—the parent material. Surface drainage is free in most places, and underdrainage is good. The natural forest growth is largely post oak, red oak, and hickory. The soils are mainly of sandy texture and are rather extensive. They have undulating to rolling relief.

**Bowie very fine sandy loam.**—In virgin areas, the surface soil of Bowie very fine sandy loam is grayish-brown very fine sandy loam, from 1 to 3 inches thick, but in plowed fields this layer is 6 or 8 inches thick. This passes into yellow or grayish-yellow slightly heavier very fine sandy loam, which grades, at a depth of 10 to 14 inches, into yellow friable fine sandy clay. Below a depth ranging from 18 to 24 inches this material is mottled with gray and contains red spots and splotches. The subsoil, although firm and compact, is friable and rather permeable. It merges, at a depth of 4 to 5 feet, with the sandy parent material, which, in places, is bluish-gray sandy clay containing large splotches of red and black soft concretions.

The surface soil is loose and structureless, low in organic-matter content, and slightly to moderately acid in reaction. The subsoil is not dense and is acid in reaction. It allows ready permeability to roots, water, and air and contains sufficient clay for the retention of a large quantity of water. This soil has developed from the less dense clay beds of the Woodbine and Trinity sands.

The surface is undulating to gently rolling, and drainage is free. Where the land is sloping, the unprotected surface soil erodes rapidly. The native vegetation is chiefly a forest of post oak, together with red oak, hickory, and other trees.

The areas of this soil are fairly uniform, except that the thickness of the soil layers varies in places largely according to slope. Small circular mounds of fine sand, from 1 to 2 feet high and ordinarily from 10 to 30 feet in diameter, occur in places. Areas of this soil, ranging in size from a few to several hundred acres, occupy the undulating uplands and smooth divides in the southern part of the county.

This is an important soil occurring on many farms in the southern part of the county. Probably 75 percent of the land is in cultivation or is idle land cleared and available for placing in crops. Plate 1, *A*, shows the relief of the soil and some of the crops on it. Roughly estimated, 40 percent of the land in crops is used for cotton, 20 percent for corn, 10 percent for peanuts, 15 percent for grain sorghums, and 15 percent for field peas, vegetables, and miscellaneous crops. In favorable seasons cotton yields from one-fifth to two-fifths of a bale to the acre, corn 12 to 18 bushels, grain sorghums 15 to 25 bushels, and peanuts 15 to 25 bushels. These yields are made under the prevailing methods of management, which on most farms do not include the use of commercial fertilizers. A small quantity of fertilizer is used, and the crops grown respond readily to such applications and to the addition of organic matter and the growing of legumes. Cowpeas grow well and are used for hay and soil improvement. This soil is well suited to fruits, berries, and many vegetables, and some are grown for home use in small orchards and gardens.

Tillage is performed with small one- and two-horse plows and cultivators. No systematic crop rotation is practiced. Some contour tillage and terracing are done to retard erosion, but much of the land is farmed without special provision for the prevention of erosion or for maintaining organic matter or fertility. Some farmers increase the supply of available plant nutrients by adding fertilizers or by growing legumes and plowing under the residue.

**Bowie fine sandy loam.**—Bowie fine sandy loam is very similar in all features to Bowie very fine sandy loam except in texture of the surface soil. In virgin areas the surface soil consists of a 2-inch layer of grayish-brown fine sandy loam passing into yellow fine sandy loam. In cultivated fields the grayish-brown fine sandy loam surface soil is 6 to 8 inches thick. The yellow layer grades, at a depth of 10 to 15 inches, into yellow friable fine sandy clay, which, below a depth of about 24 inches, is mottled with gray and red and has red spots and splotches throughout the lower part. This material becomes increasingly sandy with depth and merges with the parent materials of mottled sandy clays many feet thick. The surface soil and the subsoil are acid and permeable, and the subsoil has good water-holding capacity. The surface soil apparently is looser and contains less organic matter than the surface soil of Bowie very fine sandy loam.

On some of the more sloping areas the upper part of the subsoil is reddish yellow, and in places normal or accelerated erosion has removed considerable soil material, leaving it not more than 20 inches thick. In such places the soil material contains soft sandstone fragments.

This soil has developed from practically the same parent materials as Bowie very fine sandy loam. The relief and drainage are very similar, and the native forest growth consists of the same kinds of trees.

This soil is of considerable extent and occurs in the same general localities in the southern part of the county as does Bowie very fine sandy loam, but its area is somewhat less.

Probably 35 percent of this soil is in cultivation, and the same crops are grown, with slightly less yields under similar management than on Bowie very fine sandy loam. It is estimated that 25 percent of the land is planted to corn, 35 percent to grain sorghums, 20 percent to cotton, 15 percent to cowpeas and peanuts, and the rest to watermelons, potatoes, and vegetables.

#### NORFOLK SERIES

The soils of the Norfolk series resemble the soils of the Bowie series in general surface soil characteristics but differ in features of the subsoils. The Norfolk series includes soils with gray or grayish-brown surface soils, 2 or 3 inches thick, with yellow friable subsurface layers grading at various depths into yellow friable sandy clay. These soils are acid, low in organic matter, and of low to moderate productivity. The soils have developed from parent sandy clays that, as a rule, contain more sandy material than the parent materials of the Bowie soils, and the subsoils and substrata are generally more friable and permeable than the corresponding layers of the Bowie soils. In many places a slight mottling of gray occurs in the subsoils at a depth below 2 feet, but mottling is not typical for soils of this series. These soils support an oak and hickory forest with pine in places and only a thin stand of coarse grasses.

**Norfolk fine sandy loam.**—The surface soil of Norfolk fine sandy loam is gray or light grayish-brown fine sandy loam or loamy fine sand, 6 to 8 inches thick. In virgin areas the surface layer is only about 1 to 3 inches thick and contains some more or less disintegrated organic matter. Below this is a subsurface layer of yellow fine sandy loam, which, below a depth ranging from 10 to 16 inches, grades into yellow friable fine sandy clay or fine sandy clay loam containing a few small dark round concretions. The material becomes slightly more sandy below a depth of about 24 to 30 inches and in many places has a slight mottling of gray. It passes, at a depth of 3 to 4 feet, into the parent material, which consists of sandy clay or clayey sand irregularly mottled and splotched with yellow, gray, and red. The surface soil and subsoil layers are very permeable and acid, and the surface soil is low in organic matter. There is sufficient clay in the subsoil to hold a considerable reserve of soil moisture and prevent rapid leaching.

The principal variations included with this soil are in the thickness of the surface soil and subsoil layers, and some included areas have a slightly red subsoil. In places normal or accelerated erosion has prevented deep development of the soil.

The surface is undulating to gently rolling, and in places the slopes are moderately steep, although in most areas the slope gradient is less than 5 percent. Small sand mounds occur in some otherwise smooth areas. Drainage is rather free, and the soil is subject to severe erosion if unprotected. The native vegetation is largely post

oak, red oak, blackjack oak, and hickory, with some pine in the northeastern part of the county. This soil occurs almost entirely in scattered areas, ranging in size from 5 to 400 acres, in the northern part of the county, and is developed on outcropping beds of Trinity (Lower Cretaceous) sands.

Probably not more than 35 percent of this soil is in cultivation. Cotton and corn, the chief crops, are grown on about equal acreages. Cowpeas, peanuts, grain sorghums, and sorgo are grown to some extent on most farms. This soil is only moderately productive, and, where farmed exhaustively without recourse to practices designed to maintain and improve fertility, the yields of crops soon become rather light. On the better farms of fresher land, or where good methods are employed, the acre yields in favorable seasons average about 20 bushels of corn, one-third of a bale of cotton, or 20 bushels of peanuts. This soil is well suited to the production of some fruits, berries, vegetables, and food crops, but these are grown, as a rule, only in small plantings for home use.

Norfolk fine sandy loam is subject to severe erosion where not carefully protected, especially on slopes. It lends itself to improvement, and crops respond well to such practices as growing cowpeas or other legumes and adding organic matter, manures, and commercial fertilizers. Only thin stands of coarse grasses grow in the forest or in old fields cleared of trees. These grasses are not highly nutritious but Bermuda or other introduced grasses and forage plants affording moderately good forage can be grown.

**Norfolk fine sandy loam, deep phase.**—Norfolk fine sandy loam, deep phase, is very similar to the typical soil, but it differs principally in having a thicker subsurface layer of loose sandy material. The surface soil consists of a 2- to 4-inch layer of grayish-brown loamy fine sand grading into pale-yellow or grayish-yellow fine sandy loam or loamy fine sand. In cultivated fields the grayish-brown surface soil is 6 to 8 inches thick. In most places, below a depth ranging from 18 to 24 inches, this material passes into yellow friable fine sandy clay or fine sandy clay loam. In many places slight mottlings of gray are present below a depth of 2 feet. This material grades into the parent material of mottled gray and yellow fine sandy loam. The organic-matter content is low, and the reaction is acid throughout. This soil is rather permeable and loose and is leached more freely than typical Norfolk fine sandy loam. The subsoil, however, contains sufficient clay to hold considerable water, and the material is not so susceptible to leaching as Norfolk fine sand, which occurs elsewhere on the coastal plains.

The surface is undulating to rolling, and drainage is free, both on the surface and internally. The surface soil erodes readily on unprotected slopes. On the less sloping areas small sand mounds are present.

The natural forest growth is mainly oak, but a large proportion of the trees are blackjack oak, with fewer post oak and red oak than on typical Norfolk fine sandy loam.

This soil occurs in a number of scattered small areas throughout the northern part of the county. Approximately 35 percent of the land is cleared and used for farm crops. Probably about 30 percent of the cropland is used for corn, 30 percent for cotton, 15 percent for cowpeas, 10 percent for peanuts, and 10 percent for grain sorghums and sorgo.

Small areas of this soil are used for small home gardens, for home orchards, and for such crops as watermelons and sweetpotatoes.

Under ordinary methods of cultivation, which do not, as a rule, include the use of commercial fertilizers, this soil is not very productive, but it responds well to fertilization by legumes and the incorporation of organic matter. The acre yields on the better farmed or more freshly cleared fields average about 15 bushels of corn, 25 bushels of grain sorghums, one-third bale of cotton, 22 bushels of peanuts, and between 1 and 2 tons of sorghum hay or forage. In old fields where fertility has not been maintained, yields may be not more than half of those in the better managed fields. This soil is well suited to fruits, berries, vegetables, and various truck crops, but these are not grown except in small plantings for home use and local requirements. The soil responds well to the same methods recommended for typical Norfolk fine sandy loam.

**Norfolk loamy fine sand.**—The surface soil of Norfolk loamy fine sand is gray or grayish-brown loose loamy fine sand about 3 inches thick, although in some cultivated fields it is as much as 10 inches thick. This grades into light-yellow or grayish-yellow loose loamy fine sand, which, below a depth of 2 to 3 feet, passes into yellow fine sandy clay or fine sandy clay loam, in places mottled with gray. This, in turn, grades into a more sandy bed of yellow clayey fine sand or fine sandy clay, containing gray mottlings and red splotches. In many places the clay material lies more than 40 inches below the surface. Both the surface soil and the subsoil are acid and very permeable. In places small spots of Cuthbert and Ruston soils are included because they are too small to show on the map.

This soil occupies several fairly large and small undulating to rolling areas in the northern part of the county. Surface drainage and internal drainage are free. The soil leaches readily and erodes only moderately, as the loose material absorbs most of the rainfall and allows only a small amount of water to run off.

This soil supports the same forest vegetation as Norfolk fine sandy loam, but includes a larger proportion of blackjack oak and some bluejack oak or sandjack oak.

As this is a thin, leached soil, it is low in plant nutrients and not highly productive. It is not generally cultivated, although probably as much as 15 percent of it is in crops at various times. Probably about 35 percent of the cropland is planted in corn, 30 percent in cotton, 20 percent in grain sorghums and sorgo, and 15 percent in cowpeas and peanuts. Crops withstand dry weather very well. Yields, even in the most favorable seasons, are not high. Newly cleared land produces fair yields, but with no fertilization or addition of organic matter it becomes greatly reduced in productivity. On the better fields cotton produces about one-fourth bale or less, corn 12 bushels, grain sorghums 15 bushels, and peanuts 15 bushels.

This soil is better suited to vine crops, such as watermelons and sweetpotatoes, and such fruits as peaches, plums, and berries, and also various vegetables, than to the staple farm crops, but only small quantities of the former are grown in the home gardens. The soil responds to fertilizers and organic matter and to the growth of such legumes as cowpeas, and moderate productivity for the suited crops can be maintained by proper fertilization.

## RUSTON SERIES

The Ruston series consists of soils very similar in character to soils of the Norfolk series, but the subsoils are more red. The surface layers are grayish brown, and the subsurface layers are yellow, grayish yellow, or reddish yellow. The subsoils are reddish yellow or yellowish red, permeable, and friable. Organic matter is low, even in the virgin soils, and the reaction is acid throughout. Oxidation is somewhat more advanced in these soils than in the Norfolk or Bowie soils, as evidenced by the presence of the red color in the subsoils. These soils are associated with the Bowie, Norfolk, and other soils of the oak-hickory and oak-pine forest and are of moderate productivity. They have about the same stability for crops and similar or slightly higher productive capacity than the associated soils of the group.

**Ruston very fine sandy loam.**—The surface layer of Ruston very fine sandy loam is dark grayish-brown very fine sandy loam, which is only 3 or 4 inches thick in virgin areas but is 6 or 8 inches thick in cultivated fields. This grades into the subsurface layer of yellow or yellowish-brown very fine sandy loam. Beginning at a depth of 10 to 18 inches, the subsoil consists of reddish-yellow or yellowish-red friable fine sandy clay and becomes more definitely reddish yellow below a depth of about 30 inches. Mottled gray, red, and yellow sandy clay—the parent material—lies about 4 feet below the surface. The soil is acid and very permeable throughout, although the subsoil contains sufficient clay to prevent rapid leaching. The surface soil appears slightly darker than the surface soils of the Norfolk soils and seems to contain slightly more organic matter, especially in cultivated fields. Only slight variations occur in this soil from place to place; on some slopes the soil layers are thinner than in smooth areas.

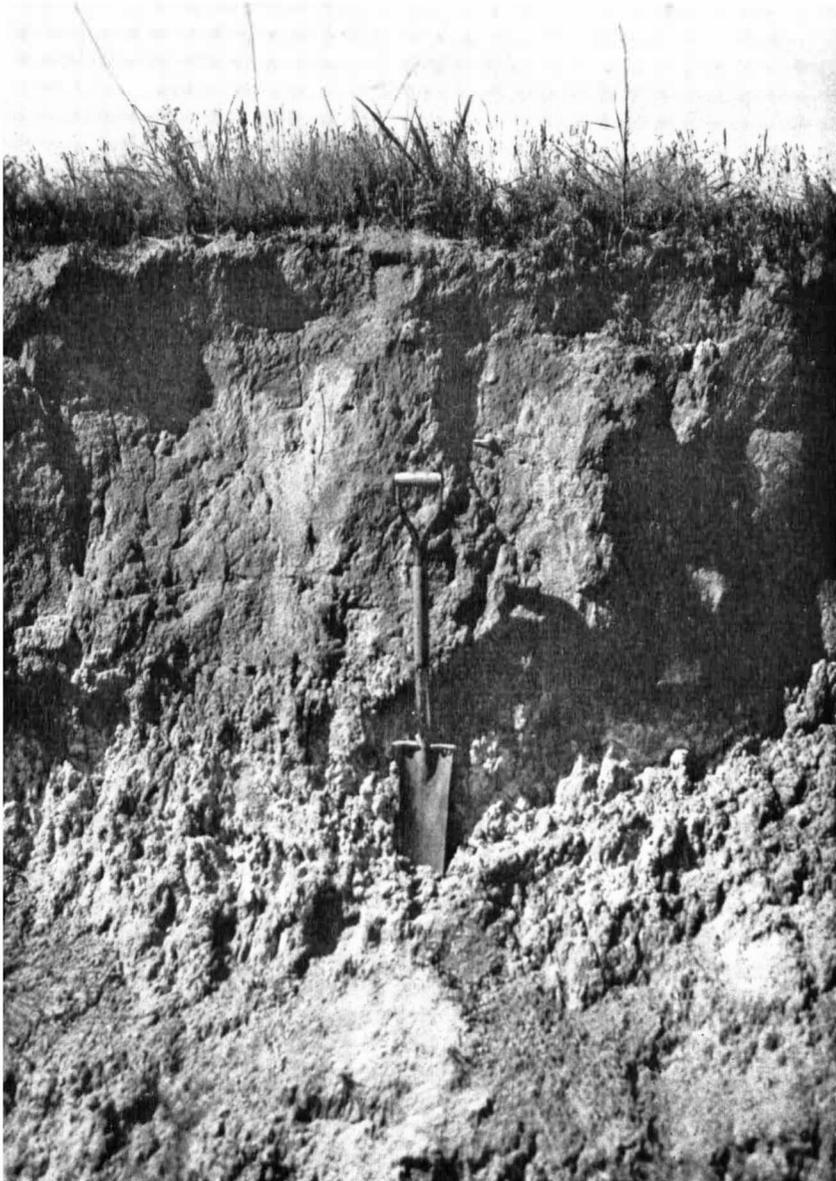
This soil occupies smoothly undulating and gently rolling areas, largely on divides, and most of the surface has a gradient of less than 5 percent. Small sand mounds occur on some otherwise smooth areas. Drainage is good throughout the soil and on the surface. Erosion may be severe where the soil is cultivated without care on the more sloping areas, and in places it shows a definite tendency for the development of gullies from accelerated erosion. It is estimated that about 20 percent of the land cleared for crops has been so severely eroded that it is used only for pasture, largely of Bermuda grass. The forest cover consists chiefly of post oak, red oak, hickory, and some associated trees.

Small areas of this soil are scattered throughout the northeastern and southern parts of the county in association with the Norfolk, Cuthbert, Bowie, and Kirvin soils, and the parent materials seem to be similar.

Probably about 75 percent of the soil has been cleared and used for crops, but not all is in cultivated crops at present. Cotton and corn, the principal crops, are grown in about equal amounts on about 70 percent of the cropland. About 20 percent of the cropland is used for cowpeas and the rest for miscellaneous crops, including small plantings of peanuts (pl. 1, *B*), sweetpotatoes, watermelons, fruit trees (chiefly peaches and plums), and vegetables or other food crops grown chiefly for home use or for incidental marketing in the local towns. This soil produces moderately good yields, probably about the same as or slightly higher than Norfolk and Bowie fine sandy loams under



A, Corn with alternating rows of cowpeas on Bowie very fine sandy loam; B, peanuts on Ruston very fine sandy loam



Soil profile of Ruston fine sandy loam near Spencerville, Okla.

similar conditions. It is suited to the same crops, and the requirements for maintaining and increasing fertility are practically the same. That is, the soil on smooth carefully farmed areas is moderately productive; and, if legumes are grown, or if organic matter, manures, and fertilizers are added, and if practices designed to prevent erosion are used, a state of very good productivity can be maintained. Although better suited to truck crops and fruits than to staple farm crops, the yields of the latter may be maintained satisfactorily by careful attention to the methods of soil improvement.

**Ruston fine sandy loam.**—Ruston fine sandy loam is very similar in character to Ruston very fine sandy loam, but the surface soil is somewhat looser and is made up more largely of fine sand instead of very fine sand. In virgin areas the 2- or 3-inch surface layer is grayish-brown fine sandy loam containing a small amount of organic matter, but in cultivated fields this layer is 6 to 8 inches thick. Below this, the subsurface soil is brownish-yellow or reddish-yellow fine sandy loam, which grades, at a depth of 10 to 15 inches, into reddish-yellow or yellowish-red friable fine sandy clay. This material gradually becomes more yellow and less red below a depth of 24 inches, and passes, at a depth of 3 to 5 feet, into the parent material of mottled red, yellow, and gray friable sandy clay. Both the surface soil and subsoil are acid and rather permeable, but they contain sufficient clay to prevent rapid leaching. Plate 2 shows a profile of Ruston fine sandy loam.

Variations occur throughout the various areas of this soil, mainly in the different shades of red and yellow in the subsoil, and in thickness of the soil layers on sloping areas where the soil material has been removed by normal or accelerated erosion. A few areas included with this soil in the northeastern part of the county have a rather deep red subsoil of moderately heavy but somewhat sandy clay. In the vicinity of Messer School, beds of rounded and subangular chert, sandstone, and quartzite gravel lie within 2 feet of the surface. On account of their small size, these areas are not shown separately on the map but are indicated by symbols. These gravel beds furnish considerable road-building material.

The surface of Ruston fine sandy loam is undulating to gently rolling. Drainage is good, and erosion is severe only on the steeper slopes where they are bare of vegetation. On the smoother surfaces the loose surface soil absorbs much of the rain water and minimizes run-off. The native vegetation is largely post oak, red oak, blackjack oak, and hickory, with some gum and pine in the northern part of the county. This soil is rather extensive and occurs in many small and some large bodies associated with soils of the Norfolk and Cuthbert series in the northern part of the county and with the Bowie and Kirvin soils in the southern part.

Probably 65 percent of this soil has been cleared for cultivation and is in crops or native-grass pasture. Probably about one-third of the land in crops is used for cotton, one-third for corn, and the rest is used for cowpeas, peanuts, and sorghums, with a small amount in home gardens, in which vegetables and fruits are grown for home and local use. In favorable seasons acre yields on the smoother fields where the soil productivity has not been greatly reduced by intensive production are about as follows: Corn, 15 bushels; cotton, one-third to one-half bale; grain sorghums, 25 bushels; and peanuts, 22 bushels.

**Ruston loamy fine sand.**—The surface soil of Ruston loamy fine sand is grayish-brown loamy fine sand about 3 inches thick in virgin areas but 6 to 8 inches thick in cultivated fields. This passes into generally reddish-yellow or brownish-yellow deep loose loamy fine sand. Below a depth ranging from 2½ to 4 feet it grades into permeable fine sandy clay or fine sandy loam that is red or mottled red and gray. This is the parent material lying at the upper part of the Cretaceous sands formations. Both the surface soil and the subsoil are acid throughout. The surface soil contains only a small amount of organic matter in the virgin areas, and in most cultivated fields a low content of organic matter is indicated by a very light grayish-brown or gray color.

This soil occupies smooth, undulating to nearly level divides. It occurs in the northern, eastern, and southeastern parts of the county, in association with other Ruston soils. It varies in places from the typical very deep sandy layers to spots where the sandy clay or sandy clay loam lies within 20 inches of the surface. The smooth areas are not subject to severe water erosion, but the unprotected dry soil drifts in heavy winds. Both the surface soil and the subsoil absorb rain water readily but leach freely and do not store a large quantity of soil water, which results in greatly reduced crop yields during long periods of dry weather. The native forest growth is chiefly blackjack oak, post oak, hickory, and pine.

Probably not more than 25 percent of this soil has been cleared for cultivation. Very little cotton is grown. With continued use for crops, yields decline considerably where measures for soil improvement are not practiced. In favorable seasons corn produces an average of about 15 bushels an acre on the better fields. This soil is suited to fruits, berries, vegetables, and various vine crops, such as watermelons and sweetpotatoes. Some of these crops are grown and produce moderate yields. The soil responds to the addition of organic matter, growth of such legumes as cowpeas, and addition of commercial fertilizers, although care should be used to prevent leaching of the fertilizers by applying side dressings at intervals during the growth of the crops rather than by placing all the fertilizer in the soil early in the season.

#### KIRVIN SERIES

The soils of the Kirvin series are somewhat like those of the Ruston series, but they have deep-red and considerably heavier subsoils. The soils of the Kirvin series have grayish-brown and reddish-brown surface layers, 3 or 4 inches thick in virgin areas, and red, reddish-yellow, or reddish-brown friable subsurface layers. The surface soil grades, at a depth of 10 to 15 inches, into red crumbly but moderately heavy fine sandy clay, which passes into soft sandy clay or sand containing fragments of soft sandstone below a depth of 3 to more than 4 feet. This is the parent material, and it is red or mottled red, yellow, and gray. The soils of the Kirvin series in this county appear to be developed more generally from the lower beds of Woodbine sands, which probably contain some glauconitic materials.

**Kirvin fine sandy loam.**—The surface soil of Kirvin fine sandy loam is brown or reddish-brown fine sandy loam, about 4 inches thick in virgin areas and from 6 to 10 inches thick in cultivated areas. It

grades into red or reddish-yellow fine sandy loam, which, in turn, at a depth ranging from 10 to 15 inches, grades into red friable moderately heavy fine sandy clay. This passes, at a depth of 3 to 4 feet, into the parent material of red or mottled fine sandy loam or sandy clay containing thin layers of soft ferruginous sandstone fragments. In many places small particles of the sandstone fragments are present in all the soil layers. The reaction is acid throughout. The subsoil is readily permeable to air, water, and plant roots and holds considerable water as a reserve for plant growth.

A number of variations from the typical soil occur in places. Normal and accelerated erosion have removed some of the surface soil on the more sloping areas, producing a very thin and eroded soil. In some places the surface soil is grayish brown with a subsurface layer of yellow or brown. A number of small areas have a large quantity of sandstone fragments scattered over the surface and throughout the soil. These areas are small and are scattered throughout the southern part of the county on slopes and outcrops near valleys and escarpments. They have a total area of several hundred acres and are shown by symbols on the map.

The surface is undulating to gently rolling (pl. 3, A), with a slope ranging from 1 to 5 percent, or slightly more in places. As a rule, the surface is more sloping than that of the Ruston soils. The soil has free drainage, both from the surface and internally, and the unprotected surface on steep slopes is subject to severe water erosion. Some fields have been cleared and were cultivated for many years but are now abandoned and deeply cut by gullies and sheet erosion. They are used only for the pasturage afforded by the thin cover of coarse native grasses that remain or by a good growth of Bermuda grass. The native forest growth is largely red oak, post oak, and hickory, but most of this has long since been cleared away. Inherently, this is one of the best sandy soils in the county, and it remains highly productive where good methods of tillage have been practiced.

Approximately 70 percent of this soil is in cultivation, and the rest is in pasture or forest. Cotton and corn are the chief crops grown. It is estimated that 40 percent of the soil devoted to farm crops is in cotton, 30 percent in corn, 20 percent in peanuts and cowpeas, and the rest is in miscellaneous crops, including small amounts of fruits and vegetables in the home gardens and orchards. It is reported that when this land was freshly cleared it produced an average of one-half bale of cotton and 20 bushels of corn an acre. This soil was one of the first to be placed in cultivation, but much of it has been farmed without using soil-improvement practices. Owing to erosion, loss of organic matter, and intensive cropping, yields have declined. In good seasons the better fields yield an average of one-third bale of cotton, 12 bushels of corn, 15 bushels of grain sorghums, and 20 bushels of peanuts an acre.

This soil is well suited to fruits, berries, and vegetables. Peaches, pears, plums, and apples are reported to grow well, and small quantities of these fruits, with some blackberries, watermelons, and sweet-potatoes, are grown. Fruits and vegetables are grown only for home use or for sale locally. Old fields sown to Bermuda grass produce good pastures. The soil responds to practices of soil improvement, including the incorporation of organic matter, the use of manures and

fertilizers, the growing of legumes, and measures to control erosion.

**Kirvin fine sandy loam, rolling phase.**—Kirvin fine sandy loam, rolling phase, is very similar to the typical soil but occupies more rolling and generally steeper areas. The surface layer is brown or reddish-brown fine sandy loam, about 4 inches thick in virgin areas and 6 to 10 inches thick in cultivated fields. This is underlain by a subsurface layer of yellowish-brown, red, or reddish-brown fine sandy loam or loamy fine sand, which, below a depth ranging from 10 to 15 inches, grades into red heavy but crumbly clay or sandy clay. The material becomes reddish yellow with depth. Below a depth ranging from 1½ to 3 feet, it is mottled with gray and contains some thin layers of soft sandstone. On steep slopes the sandstone and parent material of sandy clay lie within 2 feet of the surface in many places. The reaction is acid throughout.

The surface in most places is gently to strongly rolling, with the slopes ranging from 5 to 12 percent. Drainage is free. Erosion is severe in many places and is largely accelerated in fields that have been cultivated and is normal in forested areas. Some formerly cultivated fields have been very greatly cut by gullies, and much of the surface soil has been removed by sheet erosion.

The forest growth is largely of the same species of oak as that on the typical soil, and probably about 40 percent of the soil has been cleared and cultivated at various times. Owing to the steeply sloping eroded surfaces, much of the land is not cultivated and is in old fields with a thin growth of coarse bunchgrasses, or other grasses of low nutritive value, which are used for pasture. Bermuda grass does well where it has been planted, and it provides excellent grazing for livestock.

This soil occurs in fairly large bodies throughout the southern part of the county. Probably not more than 10 percent of the soil is used at present for cultivated crops, because of the eroded condition of much of the land. About the same crops are grown as on the typical soil, but, as a rule, yields are much lower, and probably much of the land should be placed in good pasture grasses or trees.

#### CUTHBERT SERIES

The Cuthbert series includes forested soils with light-colored grayish-brown thin surface layers and pale-yellow subsurface layers, grading into reddish-yellow friable sandy clay subsoils, which grade, in turn, at a depth of 2 to 3 feet, into the parent material of mottled sandy clay. The land is moderately to strongly rolling and, in many places, steeply sloping. The soils are low in organic matter, acid in all layers, rather permeable, and considerably leached. In this county these soils have developed from clayey sands and sandy clay beds of the Trinity sands, the basal members of the Lower Cretaceous series.

**Cuthbert fine sandy loam.**—The surface layer of Cuthbert fine sandy loam in virgin areas is light grayish-brown light fine sandy loam about 2 inches thick. This material contains very little organic matter except that derived from the decomposing leaf residue of the forest vegetation. This layer is 6 to 8 inches thick in cultivated fields. It grades into a 10- to 12-inch subsurface layer consisting of pale-yellow or grayish-yellow fine sandy loam that is very light colored in the upper part but becomes increasingly yellow with depth. At a depth ranging from 10 to 15 inches, this material, in turn, grades into yellowish-red

or reddish-yellow heavy very fine sandy clay or clay. When this clay material is dry it is rather crumbly and friable, but when moist it is somewhat plastic and adhesive. Below a depth ranging from 18 to 30 inches the material grades into interbedded layers of grayish-yellow and gray fine sand, fine sandy clay, and clayey sand of the Trinity sands of Lower Cretaceous age. This sandy material is a slightly indurated pack sand and not a true sandstone. The material in all layers is acid in reaction. Plate 4 shows two views of the soil profile of Cuthbert fine sandy loam.

Mapped areas of Cuthbert fine sandy loam include variations within short distances, principally in depth to the clay subsoil and in the color of the subsoil material. The subsoil ranges from yellow or reddish yellow to red. On steep slopes where erosion is severe the sandy surface soil and subsoil are thin and the subsoil is darker red. It is not uncommon, in areas of this soil occupying slopes, for the upper part of the slope or the brow of the hill to have a covering of yellow sand about 12 inches thick overlying a thin layer of red clay, with the sandy material and clay subsoil gradually increasing in thickness toward the lower part of the slope. The clay subsoil also changes to a yellow color. Other inclusions are small spots having a heavy subsoil resembling the subsoils of the Boswell and Sawyer soils.

Cuthbert fine sandy loam occurs only in the northern part of the county. The surface of most of the areas is rolling, the slopes ranging from 7 to 15 percent. Probably not more than 5 percent of this soil is used for the production of crops, and the rest is in abandoned fields and forest. About one-half of the cultivated land is planted to cotton and the rest to corn, sorgo, grain sorghums, cowpeas, peanuts, and other crops. If very careful attention is given to the prevention of erosion, moderate yields can be obtained even on the more sloping areas. About 10 percent of this soil has been in cultivation at various times, but, chiefly because of erosion, more than one-half of that amount is not now farmed but is used for the pasturage afforded by the native coarse bunchgrasses. Although some gullying of the abandoned cultivated areas has taken place, sheet erosion is more serious, and in many places the heavy red clay subsoil is exposed.

Because of the underlying permeable sandy clay material, this soil is well suited for the growth of a wide variety of trees. Only a few of these areas have been sodded with Bermuda grass. Most of the ground cover on these areas, as well as on the areas covered with trees, consists of native coarse grasses, mainly bluestems. The forest land has been cut over, and in most places the trees include chiefly post oak, red oak, blackjack oak, and hickory, together with some gum and pine. Many areas in the extreme northern part of the county support a thick cover of pine, both on the virgin areas and the reforested areas of the abandoned fields.

Inherently, this soil has low fertility. Organic matter should be incorporated and such legumes as peas grown for its improvement. It responds to additions of manures and fertilizers, but, because of the steep slope of the land, probably its best use is for trees or for growing such pasture grasses as Bermuda grass or other introduced grasses.

## LUFKIN SERIES

The Lufkin series includes gray soils with compact dense gray clay subsoils. These soils have been developed under forest growth on smooth surfaces from clay and sandy clay beds. They are acid in all layers. On drying, the surface soils and subsoils become very hard and compact and are cultivated with difficulty except under favorable moisture conditions. These soils are moderately productive and are not subject to severe erosion in most places.

**Lufkin very fine sandy loam.**—The 5- or 6-inch surface layer of Lufkin very fine sandy loam, under virgin conditions, is light-gray loose structureless very fine sandy loam, with a slight accumulation of organic matter in the upper part of the layer. This material is loose and powdery in dry cultivated fields. It grades into a somewhat lighter gray structureless silt loam or very fine sandy loam, which rests, at a depth of about 12 inches, on gray dense tough clay mottled with yellow in places. Below a depth of about 38 inches the material becomes very light in color and passes into somewhat friable sandy clay at a depth of several feet. The subsoil is so tough and heavy that it is almost impervious to water. The surface soil contains little organic matter and when dry becomes hard and compact where not cultivated. Both surface soil and subsoil are acid in reaction.

Low mounds on this soil have a grayish-brown very fine sandy loam or fine sandy loam surface soil, grading into a friable yellow fine sandy clay subsoil. These mounds range from 20 to 50 feet in diameter and from 1 to 3 feet in height. A few small unmappable areas of Lufkin silt loam and Lufkin silty clay loam are included.

This is not an extensive soil. It occupies small areas widely scattered throughout the northern and southern parts of the county. It is associated with the Norfolk soils in the northern part and with the Bowie soils in the southern part. The surface is very nearly level and occupies a lower position than the associated soils. Owing to the flat surface and the impervious subsoil, both surface and internal drainage are poor. After rains, water often stands on the surface for days, and even after it is finally absorbed or dries by evaporation the soil remains saturated for a long time.

Probably less than 10 percent of this soil is in cultivation. In the freshly cleared fields corn is frequently the first crop planted; elsewhere, nearly all the cultivated land is planted to cotton. Good yields of both corn and cotton are obtained in newly cleared areas, but yields of corn, especially, decrease rapidly after the first 3 years in cultivation. Probably 10 percent of the soil previously farmed now lies idle because of the decrease in yields following depletion of the natural fertility. Most of the soil in cultivation at present is along the margins of the areas where the texture is slightly lighter and surface drainage is better than normal for this soil. In freshly cleared fields corn yields about 12 bushels an acre and cotton about one-third bale, but yields differ greatly from year to year, depending largely on the amount of rainfall. Crops suffer readily on this soil either from an excess of rain or from periods of dry, hot weather.

Grasses on this soil are coarse and of little value for pasturage. In nearly all places, except in abandoned cultivated fields, the grasses form a scant cover beneath a thick growth of trees. This land has

been cut over and the trees are of little value except for ties and firewood. The trees consist chiefly of post oak, water oak, red oak, willow oak, blackjack oak, hickory, and elm.

For best results in farming this soil, drainage should be established and a good supply of organic matter maintained. It is not very well suited to fruits or vegetables, but these could be grown where drainage is not too deficient. Sorghums and grasses should do fairly well.

#### SAWYER SERIES

The Sawyer series includes forested light-colored soils with yellow friable surface soils grading into yellow crumbly clay subsoils which, in turn, grade into rather dense mottled yellow, red, and gray clay. These soils have developed from sandy clays of the Woodbine sand formation. They are acid in all layers and occupy undulating areas with fairly good surface drainage and slow underdrainage. The soils have moderate productivity. They are somewhat similar to the Bowie soils but differ in that the lower subsoil layers are much heavier and less permeable.

**Sawyer very fine sandy loam.**—The surface layer of Sawyer very fine sandy loam, under virgin conditions, is grayish-brown very fine sandy loam, 2 or 3 inches thick, but in cultivated fields it is 6 or 8 inches thick. It grades into a 9- to 12-inch layer of light grayish-yellow very fine sandy loam, which, in turn, grades into light-yellow friable very fine sandy clay slightly mottled with gray in places. Below a depth of about 22 inches this material is underlain by heavy dense clay, mottled with gray, red, and yellowish red. The surface soil in cultivated fields is grayish yellow or grayish brown. In most freshly cleared fields the amount of organic matter in the surface soil appears to be moderate and perhaps equal to that in the surface soils of the Bowie and Norfolk soils; but after several years of cultivation the organic matter becomes depleted where no systematic return of this material is practiced. The surface soil and the subsoil are acid in reaction.

Variations of this soil from place to place include, in general, differences in color, texture, and thickness of the surface soil and upper subsoil material. In the more nearly level and poorly drained areas the surface soil and upper subsoil material is gray and mottled slightly with yellow. In these places the amount of organic matter is low and the crop yields, even in freshly cleared fields, are comparatively low. Although the depth to the heavy dense clay subsoil differs somewhat over most of the mapped areas, the greatest differences in depth are along the lower and upper parts of the slopes. Where the surface is undulating the surface soil is thin and in many places the yellow clayey upper subsoil layer is exposed, particularly on the crest of the narrow slopes or ridges. In places there are small spots of soils having reddish-yellow or yellowish-red heavy subsoils. These inclusions probably are phases of the Boswell soils.

Sawyer very fine sandy loam occupies the nearly level or flat areas of the broad stream divides, associated, for the most part, with light-colored soils of the Norfolk, Bowie, Boswell, and Lufkin series, but in a few localities in the southwestern part of the county it is associated with isolated areas of Durant soils. The areas range from 5 to 300 acres or more in size. Most of the areas are smooth and nearly

level, with sufficient slope to allow run-off of surface water. Run-off however, is slow, and the soil remains soaked for many days after heavy rains. In some areas the surface is dotted by small sand mounds, giving an uneven microrelief similar to that of some areas of the Bowie and Norfolk soils.

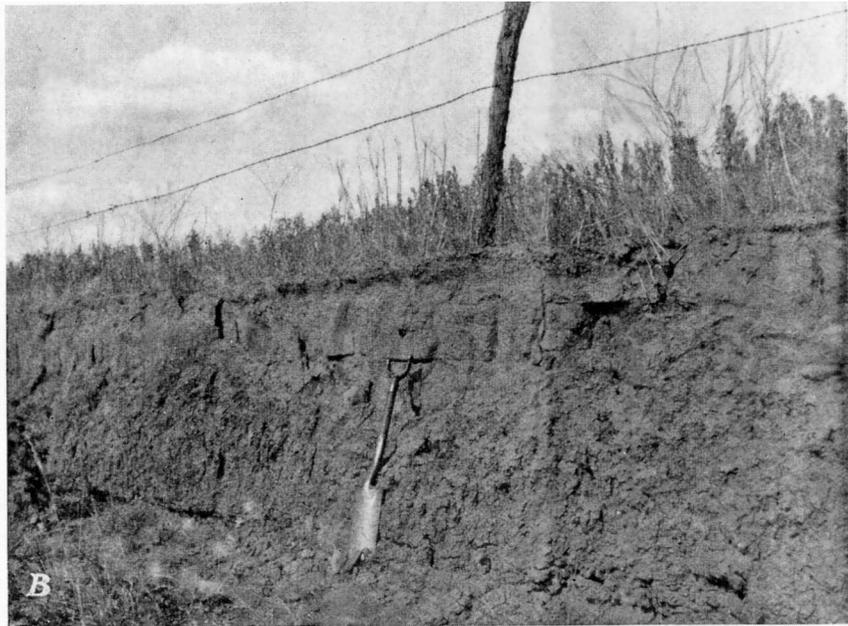
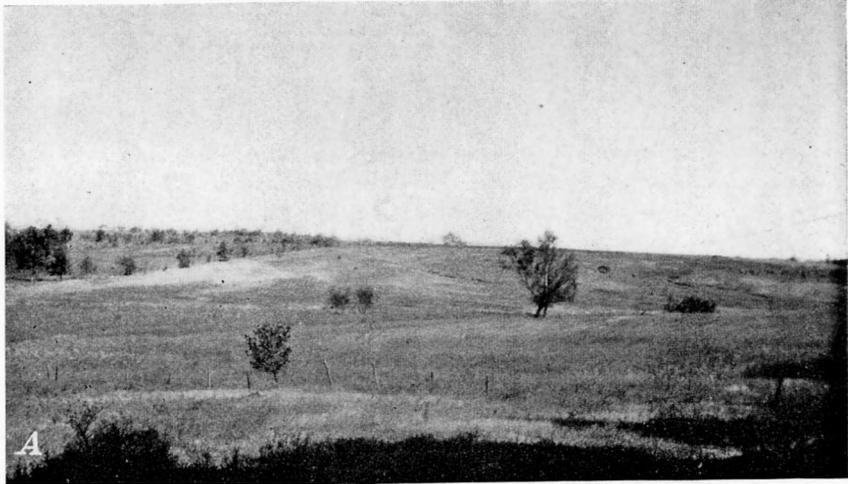
Probably 40 percent of the land is tilled, and the rest is covered with a forest growth of post oak and other oak and hickory trees. Cotton, corn, sorgo, and cowpeas are the principal crops grown. About 40 percent of the cropland is devoted to the production of cotton, 30 percent to corn, 15 percent to cowpeas, and the rest to sorgo and miscellaneous crops. These crops produce fairly well over a long period in cultivation, provided attention is given to maintaining a supply of organic matter, although considerably greater yields are obtained in freshly cleared fields. On recently cleared land or fields where good methods of soil improvement are used, cotton yields about one-third bale and corn 20 bushels an acre. A small part of the land not in cultivation is cleared, mainly in the more poorly drained areas, and used for pasture, which affords rather poor grazing because of the scant cover of coarse grasses. Very few Bermuda grass pastures have been established on this soil, but it is probable that this or other grasses could be grown to produce good grazing. The soil responds to manures and fertilizers, the incorporation of organic matter, and the growing of legumes, such as cowpeas.

#### BOSWELL SERIES

The Boswell series includes forested light-colored acid soils with yellow friable subsurface layers, resting on rather dense heavy red or yellowish-red clay subsoils, which, in the lower part, contain mottlings of gray. The parent material consists of mottled sandy clay of the Woodbine sand formation. These soils are somewhat similar to the Kirvin soils but differ chiefly in that the subsoils are much more dense and heavy than those of the Kirvin soils. These soils are of only moderate productivity and are very susceptible to sheet and gully erosion.

**Boswell very fine sandy loam.**—The 2-inch surface layer of Boswell very fine sandy loam, under virgin conditions, is grayish-brown very fine sandy loam. It contains a small amount of organic matter, enough to give it a slightly dark color. This layer grades into light grayish-yellow or yellow very fine sandy loam faintly mottled with gray in places. At a depth of 8 to 12 inches this material, in turn, grades into red or reddish-yellow heavy rather dense structureless clay, mottled with gray and yellow below a depth of about 22 inches. The surface soil and the subsoil are acid in reaction. The small amount of organic matter in the surface soil rapidly becomes depleted under cultivation, and after a few years of cultivation the topmost 6 inches of soil is light grayish brown.

In several included areas, normal and accelerated erosion have thinned the surface soil and the subsoil. Colors vary according to slope and drainage. Generally, in places where the surface soil is very light in texture and rather thick, the subsoil is less dense. In several areas in the northern part of the county in the vicinity of Nelson, the material below a depth of 30 inches, or below the heavy red clay sub-



*A*, Characteristic relief of Kirvin fine sandy loam on old fields no longer in cultivation; *B*, profile of Durant silt loam 1 mile southwest of Forney School.



A and B, Two views of the soil profile of Cuthbert fine sandy loam 3 miles north of Fort Towson, Okla.

soil, is fine sandy clay or fine sandy loam. The most common inclusions are small areas of Bowie very fine sandy loam and Norfolk fine sandy loam too small to indicate on the map.

Boswell very fine sandy loam occupies widely scattered areas in the northern and southern parts of the county, ranging in size from 5 to 200 acres, associated with areas of the Bowie, Norfolk, Sawyer, Lufkin, and other light-colored soils. The larger areas are on the broader divides and ridges and long slopes.

The relief ranges from gently undulating to gently rolling. Surface drainage is everywhere good, but, because of the dense plastic heavy clay subsoil, internal drainage is poor. In places where the upper sandy layers are thicker than is common, internal drainage for shallow-rooted crops is fair, but water moves very slowly through the clay subsoil. Because of the impervious character of the subsoil material, the soil erodes severely where unprotected, especially where the surface is sloping. During torrential and sudden rains, most of the water is lost by rapid run-off. Water saturates the clayey subsoil to considerable depth during the long rainy periods common in the winter, making it sticky and puttylike.

Crop yields on Boswell very fine sandy loam are low, chiefly because of the low content of organic matter and the imperviousness of the subsoil material. In freshly cleared fields, however, cotton yields about one-third of a bale an acre, or slightly more. Probably not more than 10 percent of this soil is in cultivation. About 60 percent of this is planted to cotton, and the rest is devoted about equally to corn, grain sorghums, cowpeas, and peanuts.

Blackjack oak, post oak, and some red oak and hickory trees make up the native forest, and pine trees grow in the northern part of the county. In most places the tree growth is comparatively thin, but the grass cover is thicker than on most of the other light-colored soils. Some of the larger areas are well suited for pasture, especially in the southwestern part of the county where the stand of bluestems is thickest.

#### LIGHT-COLORED SOILS OF THE FORESTED TERRACES

The light-colored soils of the forested terraces are very similar to the light-colored soils of the forested uplands, but they are developed from old alluvium (in places probably Quaternary in age). Like the soils of the first group, these soils have gray or grayish-brown sandy surface soils underlain by clay or sandy clay subsoils. The content of organic matter and plant nutrients is low, and the reaction is slightly acid to acid. Like the soils of the first group, these soils may be placed in two subgroups: (1) Soils with sandy permeable subsoils, which include members of the *Kalmia* and *Cahaba* series, and (2) soils with heavy-textured subsoils, which include members of the *Myatt* series. The *Kalmia* and *Cahaba* soils are moderately productive, but deficient drainage lowers the value of the *Myatt* soils.

#### KALMIA SERIES

The *Kalmia* series includes forested soils that have thin grayish-brown surface soils, with pale-yellow or grayish-yellow subsurface soils of friable material, grading into yellow sandy clay subsoils. These soils are somewhat like the Norfolk soils. They are developed on

smooth terraces of old alluvium in the higher parts of stream valleys. These soils are smoother and generally have thicker surface soils than the Norfolk soils. As a rule they have a higher water table.

**Kalmia very fine sandy loam.**—The surface layer of Kalmia very fine sandy loam consists of dark grayish-brown very fine sandy loam, 2 to 4 inches thick under forest conditions and 8 to 10 inches thick in cultivated fields. This grades into light grayish-brown or pale-yellow very fine sandy loam, which becomes increasingly yellow with depth and, at a depth ranging from 12 to 18 inches, grades into yellow friable fine sandy clay. Below a depth of about 3 to 4 feet the material is grayish-yellow fine sandy clay mottled with gray and yellowish red. This soil is low in organic matter and is acid in reaction.

Several variations are included in areas of this soil. In the lower or depressed areas the surface soil is lighter colored and the subsoil is somewhat heavier textured and considerably more mottled with gray in the lower part. On mounds and in other better drained areas the surface soil and the subsurface soil are lighter textured and the subsoil is darker yellow or reddish yellow. These inclusions comprise small spots of Myatt and Cahaba soils or phases of those soils.

Kalmia very fine sandy loam occupies high ancient terraces adjacent to the first bottoms of the Red and Kiamichi Rivers and Clear Boggy and Muddy Boggy Creeks. Most areas of this soil lie from 20 to 30 feet above the bottom lands that are subject to periodic overflow, although some areas lie only slightly above the flood plains. The surface is generally smooth and nearly level. Many areas near the Red River bottom lands include numerous connecting sinuous depressions and low mounds.

The native trees are mainly oaks similar to those on the Norfolk soils. Approximately 80 percent of this soil is in cultivation or is cleared and available for cultivation or pasture. About 40 percent of the cultivated land is devoted to cotton, 25 percent to corn and grain sorghums, 20 percent to cowpeas, 10 percent to peanuts, and the rest to small plantings of vegetables, fruits, and miscellaneous crops produced for home use. Nearly all of this soil now farmed has been in cultivation for many years and has lost much of the available plant nutrients. It is reported that for the first 2 or 3 years in cultivation it will produce, in favorable seasons, as much as 18 bushels of corn and one-half bale of cotton to the acre. The productiveness can be maintained with proper management, although it is difficult to prevent erosion on mounds and on the sloping sides of depressed areas. In most places farmers have cultivated this soil for a number of years, without rotations or soil-improvement practices, to clean-cultivated crops, and yields have been reduced. Under these conditions in years of normal weather conditions cotton yields about one-fourth bale an acre, corn 14 bushels, grain sorghums 18 bushels, and peanuts 15 bushels.

Although some of the land not in cultivation has been cleared or previously farmed, most of it is covered with forest consisting of post oak, blackjack oak, and some red oak and hickory trees. Some pasturage is obtained from the native grasses, chiefly wire grass, blue-stem, and other coarse grasses. In many areas much of the surface is covered with Bermuda grass, and such areas provide considerable pasturage.

**Kalmia fine sandy loam.**—In cultivated fields the surface soil of Kalmia fine sandy loam is grayish-brown or light grayish-brown loose fine sandy loam, from 6 to 12 inches thick. This grades into yellow or dark-yellow loose light fine sandy loam, which passes, at a depth ranging from 12 to 18 inches, into yellow friable fine sandy clay. Below a depth of 30 to 40 inches this is underlain by yellow heavy very fine sandy loam or fine sandy clay mottled with reddish yellow and gray. This soil closely resembles Norfolk fine sandy loam, but the layers merge more gradually. The surface soil and the subsoil are permeable, and underdrainage is good. The parent material below is rather uniform in characteristics, although it becomes slightly heavier and more mottled with gray as the depth increases. The surface soil and the subsoil are acid in reaction.

Most of this soil is along and adjacent to the bottoms of the Red and Kiamichi Rivers and Clear Boggy and Muddy Boggy Creeks, on terraces from 10 to 25 feet above the bottom land.

The surface is nearly level or very gently undulating. Many undulations caused by old stream courses and sinuous depressions produce an uneven microrelief.

About 60 percent of this soil is in cultivation. Probably 50 percent of the cultivated land is planted to cotton, 20 percent to corn and grain sorghums, 15 percent to peanuts and cowpeas, and the remainder to other crops, including potatoes, sweetpotatoes, and vegetables. In freshly cleared areas, cotton yields, in seasons of normal weather conditions, a little more than one-third bale an acre, corn about 18 bushels, and peanuts 20 bushels. Under cultivation, yields on this soil decrease rapidly where little attention has been given to soil improvement or the maintenance of fertility. About 20 percent of the soil has been cultivated but is now idle or in native grass pastures.

This soil does not afford good native pasture. The pasturage on a few areas has been improved by introducing Bermuda grass, but most of the grass consists of little bluestem, wire grass, and other coarse grasses. The forest has been cut-over, and that remaining is of little value except for firewood. The forest growth consists chiefly of blackjack oak, post oak, and some red oak and hickory.

Manures, fertilizers, the incorporation of organic matter, and the growing of cowpeas materially increase crop yields.

**Kalmia fine sand.**—The 5-inch surface layer of Kalmia fine sand in cultivated areas is gray fine sand, which grades into a thick sub-surface layer of fine sand that is light yellow in the upper part and becomes increasingly darker yellow with depth. Below a depth of 40 inches the material merges with yellow heavy fine sandy loam mottled with gray and grayish yellow in places. In virgin areas the surface soil is light grayish brown to a depth of about 2 inches, but during cultivation the small amount of organic matter in this layer is mixed with the gray fine sand, causing the surface soil to be light in color. The low organic-matter content and the light texture are conducive to blowing and drifting by heavy winds unless some protection is afforded by crops or crop residues. Both the surface soil and the subsoil are acid in reaction.

The total area occupied by Kalmia fine sand is not large, and generally it occurs in small scattered bodies, chiefly on the older terraces adjacent to the Red River and Kiamichi River bottom lands. A few

other small areas are adjacent to the Muddy Boggy and Clear Boggy Creeks bottom lands, especially northeast of Boswell, and along Frazier and Spencer Creeks west of Spencerville. Except along the small creeks, this soil is associated with Myatt and other Kalmia soils. Nearly all the areas are on the lower ancient terraces a few feet above the overflowed bottom lands. Their surfaces are nearly level or very gently undulating. Because of the porous sandy surface soil and subsoil, internal drainage is rapid and very little water is lost by run-off.

Probably 85 percent of this soil is cleared and in cultivation or in pasture land available for cultivation, and the rest is forested with blackjack oak, post oak, and some red oak and hickory. About 35 percent of the cultivated land is planted to cotton, 25 percent to corn, 20 percent to grain sorghums and sorgo, 15 percent to peanuts and cowpeas, and the rest to miscellaneous crops. Newly cleared fields are productive for a few years, but yields decrease rapidly unless special attention is given to prevent the depletion of organic matter. In areas cultivated for a number of years cotton yields an average of about one-fifth bale an acre, corn 8 bushels, grain sorghums 15 bushels, and peanuts 15 bushels. Cowpeas grow well, and the growing of this crop or some other legume improves the soil. Organic matter should be incorporated in order to increase the productivity of the soil. The soil responds to the application of manures and fertilizers. This soil is suited to truck crops, vegetables, and fruits, especially to watermelons and sweetpotatoes.

#### CAHABA SERIES

The Cahaba series includes forested soils developed from old non-calcareous sandy clay alluvium on high smooth terraces lying above the flood plains in valleys. These soils have thin grayish-brown surface layers, yellow or reddish-yellow friable subsurface layers, and reddish-yellow friable sandy clay subsoils. Oak and hickory trees, for the most part, make up the forest. These soils are acid throughout and very permeable, although the subsoil is sufficiently heavy to retain considerable moisture. The surface is generally smooth, and surface and subsoil drainage are good. The soils of this series in this county are sandy and suited to fruits, berries, vegetables, and various food crops, such as watermelons, sweetpotatoes, peanuts, and others. These soils are moderately productive, but when farmed without regard to the maintenance of soil fertility they decrease considerably in productivity. For best production they require the incorporation of organic matter and the growing of legumes, such as cowpeas. They respond well to the addition of manures and fertilizers.

**Cahaba very fine sandy loam.**—The surface soil of Cahaba very fine sandy loam, in virgin areas, is grayish-brown light very fine sandy loam, about 4 inches thick, but in cultivated fields it is 8 inches thick. This grades into light grayish-brown or yellow very fine sandy loam, which, below a depth of 12 to 15 inches, grades into reddish-yellow or light-red friable very fine sandy loam. This merges within a few inches with yellowish-red or light-red friable fine sandy clay. Below a depth of 36 inches the subsoil becomes reddish-yellow permeable fine sandy clay mottled with gray, and the gray increases with depth.

In most places layers of sand and fine gravel are below a depth of 4 feet. The material in the surface soil and subsoil layers is acid in reaction.

This soil is not very extensive. It occurs mainly on the terraces of the Kiamichi River, in areas ranging from 5 to 200 or more acres. Their surfaces are smooth and gently undulating, or slightly more undulating than those of the Kalmia soils. Surface drainage is rapid, although not so excessive in most places as to cause serious damage by erosion.

The chief variations in the mapped areas of this soil are those in which the surface is more sloping and where the surface soil has washed away and exposed the red or yellowish-red subsoil. In the lower places and along the edges of the areas, the surface soil is slightly thicker and is lighter in texture and the subsoil is yellow and resembles more nearly the Kalmia soils. In a few places in sec. 12, T. 5 S., R. 17 E., and in sec. 7, T. 5 S., R. 18 E., the soil is shallow and gravelly material lies within 30 inches of the surface. Small circular mounds are present in places.

Although much of this soil occurs in comparatively small irregular areas closely associated with the poorly drained Myatt soils and soils of the bottom lands, about 70 percent is cultivated. Probably about 45 percent of the cultivated land is planted to cotton, 35 percent to corn, 10 percent to cowpeas and peanuts, and the rest to miscellaneous crops. The soil produces well after many years in cultivation, if attention has been given to the maintenance of fertility by adding organic matter and growing legumes. In years of normal weather conditions, cotton yields about one-third bale an acre, corn 15 bushels, and peanuts 15 bushels. In freshly cleared fields the yields are slightly higher; here, cotton yields as much as one-half bale and corn 20 bushels an acre.

#### MYATT SERIES

The Myatt series includes gray forested soils with dense heavy gray clay subsoils. These soils occupy smooth areas with very deficient drainage on stream terraces lying high above overflow and are developed from old alluvium. The reaction is acid. On drying, the surface soils and subsoils bake tightly to a hard mass. These soils are forested and very similar to the Lufkin soils but have a higher water table and slightly poorer drainage. Owing to imperfect drainage they are not esteemed highly for farm crops.

**Myatt very fine sandy loam.**—The surface soil of Myatt very fine sandy loam, to a depth of 2 to 4 inches in virgin areas, is grayish-brown very fine sandy loam. This grades into gray very fine sandy loam, in many places faintly mottled with dark grayish brown, which rests, at a depth of 15 to 20 inches on gray dense heavy clay mottled slightly with yellow. Except in the topmost 1 or 2 inches of the surface soil the organic-matter content is low. The dense clay subsoil is almost impervious to water. Both the surface soil and the subsoil are acid in reaction.

This soil occurs on the terraces or second bottoms adjacent to the Red River and the Kiamichi River bottom lands and in a few scattered areas along Muddy Boggy and Clear Boggy Creeks, in many places associated with the Kalmia soils. The surface of the areas is

nearly level, but many low dome-shaped sand mounds, ranging from 20 to 50 feet in diameter, give an uneven microrelief. These mounds consist of sandy soils, largely of the *Kalmia* series, and in places they are so numerous as to occupy 50 percent of the land surface. Natural drainage on the surface and in the subsoil is slow, and water stands for a long time after rains.

Probably about 20 percent of the land is in cultivation. About 60 percent of the tilled land is planted to cotton, and most of the rest is devoted to corn. Crop yields vary somewhat from field to field. The most unsatisfactory yields are obtained in areas having the most deficient drainage and the thinnest surface soil. Most of the tilled areas are those where the mounds are less pronounced, the surface soil is comparatively light textured, and the clay subsoil lies below a depth of 24 inches. Freshly cleared land having sufficient surface drainage produces about one-half bale of cotton and 20 bushels of corn an acre. The fertility of the soil diminishes rapidly, and after several years of cultivation the yields of cotton and corn drop to about one-fourth bale and 12 bushels an acre, respectively.

This land is of little value for grazing, as the pasturage consists, for the most part, of coarse native grasses. It supports a thick forest, chiefly of water oak, willow oak, post oak, blackjack oak, red oak, elm, hackberry, and hickory.

This soil may be improved by providing artificial drainage and incorporating organic matter. It is probable that some pasture grasses would do well and provide good grazing. The soil is not well suited to fruits and vegetables.

**Myatt silt loam.**—The surface soil of Myatt silt loam is dark grayish-brown or gray silt loam, which grades, at a depth of about 9 inches, into light-gray structureless heavy silt loam with small spots and splotches of light yellow and yellowish brown below a depth of 12 to 14 inches. At a depth ranging from 18 to 24 inches this rests on gray dense heavy clay mottled in places with grayish brown. Below a depth of about 50 inches the clay is less dense and more silty. The clay subsoil is almost impervious to water, air, and roots. Both the surface soil and the subsoil are acid in reaction.

This soil occurs in close association with Myatt very fine sandy loam. A few bodies of Myatt silty clay loam and Myatt very fine sandy loam are included with this soil on the map, but the chief variation includes the small scattered mounds on which the soil is *Kalmia* very fine sandy loam or a phase of that soil. In general, the mounds are not so numerous as on Myatt very fine sandy loam; in many areas they are absent, and the relief is uniform except for small slight depressions. This soil is acid in reaction, except in a few places southeast of Grant, where it is neutral in reaction. The growth of saltgrass and the wilting of crops indicate the presence of soluble salts in places where the soil is neutral in reaction.

Practically none of this soil is cultivated, except in a few fields occupied chiefly by other soils. Because of the nearly level surface and the absence of natural drainage channels, surface drainage is very slow. The impervious subsoil also makes internal drainage very deficient, and in many places the surface is covered with water for a long time during protracted rainy periods. Nearly all of the soil supports a

thick forest cover, largely water oak, willow oak, post oak, elm, and some hackberry and hawthorn. The scant grass cover consists of coarse grasses that tolerate poor drainage conditions.

**Myatt silty clay loam.**—The 5-inch surface soil of Myatt silty clay loam in virgin areas is light grayish-brown or gray silty clay loam, with a slight amount of organic matter in the topmost inch. This rests on dark-gray heavy dense clay that is almost impervious to water, roots, and air. Below a depth of 36 inches the material gradually becomes slightly lighter in texture, but underdrainage is very deficient. The reaction is acid to a depth of about 36 inches, and below this it is neutral. Absence of an acid reaction of the soil in some areas southeast of Grant may possibly be associated with the presence of harmful soluble salts similar to those in Myatt silt loam.

Aside from a few small areas of *Kalmia* very fine sandy loam on mounds similar to those on areas of other Myatt soils, this soil is uniform over the area of its occurrence. In two areas, however, in the eastern part of secs. 20 and 29, T. 7 S., R. 18 E., the surface soil to a depth of about 12 inches is dark grayish brown and shows some evidence of accumulation of organic matter. In these areas surface drainage is adequate and crop yields are higher than average. The subsoil contains fine black concretions in many places.

Except for a few scattered bodies of Myatt silty clay loam along the Kiamichi River and along the lower reaches of Muddy Boggy Creek, this soil occurs on terraces adjacent to and considerably higher than the flood plain of the Red River. The areas are closely associated with Myatt silt loam. The surface is very nearly level, and in some places it is slightly depressed. Surface drainage is very slow, and water remains on the surface for long periods after rains. Slightly depressed areas have slightly slower surface drainage than that of Myatt silt loam. Low dome-shaped mounds similar to those on the other Myatt soils are practically absent.

Probably less than 5 percent of Myatt silty clay loam is in cultivation. Parts of a few areas southeast of Grant have fairly good surface drainage, and some crops are grown on them. The principal crop is cotton, but some corn is also produced. In years of moderate rainfall cotton grown in the better drained areas produces about one-fourth bale an acre, but freshly cleared fields in favorable seasons have produced as much as one-half bale. This soil supports a scant cover of grasses, even in cleared areas, and forested areas are nearly bare of grass. The forest cover consists of willow oak, water oak, hackberry, and some post oak, red oak, hickory, and hawthorn. This soil requires adequate drainage to be used for crops, and probably ditching would be moderately effective. Some feed crops, such as sorghums and grasses, might be grown very successfully if drainage were better. The soil is not suited to fruits or vegetables.

#### DARK-COLORED SOILS OF THE UPLAND PRAIRIES

The group of dark-colored soils of the undulating to rolling upland prairies are developed from limestones, calcareous shales, and clays of the Lower Cretaceous formations. Where deeply developed, these soils include noncalcareous layers, although some are shallow and calcareous. Most of these soils are farmed, and more attention is given to raising livestock than on the other soils. Although these soils produce

most of the small grains grown in the county, cotton, corn, grain sorghums, and other crops are grown also. This group includes soils of the San Saba, Denton, Newtonia, Durant, Choctaw, and Crockett series, which occupy a general east-west belt of more or less connected areas through the central part of the county.

#### SAN SABA SERIES

The San Saba series includes very dark-gray to black soils of the prairies that have heavy dark-gray clay subsoils and are underlain by limestone at a depth of several feet. In places the limestone is less than 3 feet below the surface. These soils generally are noncalcareous, although locally small spots have sufficient lime (calcium carbonate) to effervesce with hydrochloric acid. The surface is undulating to rolling, and the virgin soils support a good growth of bluestems, grama, and other native grasses.

**San Saba clay.**—San Saba clay is one of the most productive soils of the county. The surface soil of very dark-brown or black crumbly clay is about 10 inches thick and has a slightly granular structure. It grades into black or dark-gray waxy crumbly heavy clay, which continues to a depth of several feet. In places the subsoil grades into brown or yellow waxy clay below a depth of 30 inches, and in places this material is mottled with gray. The depth to limestone is rather variable, but in most places it is 36 or more inches. This soil is neutral in reaction, but it contains free lime in most places below a depth of 20 inches.

Several variations occur in areas of this soil. The chief one consists of a soil having a grayish-brown subsoil mottled with gray. This inclusion generally occupies slightly lower, more poorly drained areas than does the typical soil. At higher elevations the surface soil is thinner than is typical and is very dark brown, resembling the surface soil of Denton clay. Associated with these spots in several places are areas of San Saba clay, shallow phase, which are too small to be shown on the map. The texture of the surface soil in the areas west of the Kiamichi River is very slightly lighter than is typical, and in places it is a silty clay loam.

Areas of San Saba clay lie in the central part of the county, closely associated with other soils of the prairies, chiefly San Saba clay, shallow phase, and soils of the Denton series. The surface in most places is slightly undulating. The areas occupy broad flat divides, slopes, swales, and sags along drains. Most areas have adequate surface drainage and underdrainage for growing crops, although drainage on some lower slopes and flat areas is very slow.

Probably about 80 percent of this soil is in cultivation. About an equal acreage is planted to corn and cotton, which take up about 70 percent of the cultivated land. About 20 percent is planted to oats, and the rest to cowpeas and miscellaneous crops. In years of normal weather, corn yields about 35 bushels an acre, cotton one-third to one-half bale, and oats about 40 bushels. Native-grass hay produces about 2 tons an acre, but nearly all areas of this soil used as hay land have been in cultivation and are now producing Johnson-grass hay, which yields slightly more than the native grasses.

**San Saba clay, shallow phase.**—The 6- to 10-inch surface soil of San Saba clay, shallow phase, is very dark-brown or black crumbly

slightly granular clay in which the granules are rounded and sub-angular. This grades into black, gray, or yellow crumbly but rather waxy calcareous clay, which rests on limestone or disintegrated fragmentary limestone at a depth of 20 to 30 inches. The reaction is neutral. Fragments of unweathered limestone are scattered over the surface and throughout the soil in most places, but the subsoil is calcareous in many places. Limestone outcrops in a few areas, particularly those south and southeast of Fort Towson. In places the limestone is in large flat fragments that stand on end.

Most of this soil occupies upper slopes and ridges where the surface is gently sloping. Probably about 60 percent is cultivated. Most of the uncultivated areas are covered with native coarse grasses, dominantly species of *Andropogon*, with a few scattered Osage-orange (bois d'arc) trees, elm, locust, and an occasional oak. About 40 percent of the cultivated land is planted to cotton, 30 percent to corn, 20 percent to oats, and the rest to cowpeas, sorgo, and various other crops. Yields of cotton range from one-fourth to one-third bale an acre, and corn from 12 to 25 bushels. Organic matter is abundant; nevertheless, crops suffer quickly during periods of very dry weather, owing to the thinness of the surface soil and the low water-holding capacity of the subsoil. Although most of the uncultivated areas are used for pasture, they are also used to some extent for producing hay. The large limestone rocks in places interfere with mowing the hay.

This soil occurs in widely scattered areas in the central part of the county, associated with other soils of the prairies. The larger areas are north and northwest of Hugo and southeast of Fort Towson.

As the soil erodes rather readily in cultivated fields, methods should be employed to prevent serious erosion, which greatly reduces the value of the soil for crop production. Probably the best methods are cultivating on the contour, strip cropping, and terracing.

#### DENTON SERIES

The Denton series includes brown calcareous moderately deep and immature soils with yellow or brown crumbly calcareous clay subsoils. These soils occupy undulating to rolling prairies and have developed from limestone or interbedded limestone and marl strata, belonging to the Lower Cretaceous formations. These soils support a heavy growth of coarse native bunchgrass and some grama. They are moderately productive and are suited especially to grasses and feed crops, also to small grains. They are associated with the San Saba soils but differ in being thinner, more calcareous, more crumbly, and less dark. The shallower soils afford excellent pasture but are not so productive as the deeper soils, which are used largely for the production of farm crops.

**Denton clay.**—The 10-inch surface soil of Denton clay is brown crumbly clay. It grades into grayish-brown or yellowish-brown heavy massive clay. Generally below a depth ranging from 2½ to 5 feet this material in turn grades into disintegrated limestone or rests on hard limestone strata, but in places the parent material or limestone is within 18 inches of the surface. In places the surface soil grades into brown heavy clay sprinkled slightly with gray, which gives way at a depth of 20 inches to dark-yellow or yellowish-brown tough heavy

clay. In places the subsoil below a depth of 34 inches is gray heavy clay streaked and spotted with yellow. Soft concretions of lime are present in the lower part of the subsoil. The surface soil is very slightly acid in reaction, and the subsoil is neutral. Although the surface soil and the subsoil are heavy textured, they are not especially impervious to roots and water, and the surface soil works to a friable condition where cultivated. Except in periods of torrential or sudden rains, much of the rain water is absorbed and run-off is not excessive. This soil has some characteristics similar to those of the heavier Durant soils. In most places limestone lies within a depth of 6 inches, and a few limestone rocks are on the surface.

As mapped this soil includes some narrow streaks and small spots of Wilson, Durant, and San Saba soils that are too small to indicate on the map. In places these inclusions form an intricate pattern, and on recently plowed land the mixed color of the variations is pronounced. Such areas are east of Fort Towson and south of Swink.

The land is gently undulating, and surface and internal drainage are slow but sufficient for the removal of surplus water. This soil is associated with areas of Denton clay, shallow phase, and the San Saba and Durant soils on the prairie lands in the central part of the county. The areas range from 10 to 280 acres in size and in most places adjoin areas of other soils that are suitable for cultivation. Probably not less than 95 percent of the land is in cultivation.

Denton clay is one of the most productive soils of the prairies. The acreages devoted to the various crops are approximately the same as those on Durant silty clay loam. About 35 percent of the cropped land is devoted to cotton, 40 percent to corn, and the rest to oats, cow-peas, and a few other crops. In years of normal weather conditions, acre yields are about 30 bushels of corn, one-half bale of cotton, and 40 bushels of oats.

This soil has developed under a heavy cover of bluestem and other bunchgrasses. The amount of organic matter in the surface soil is about as easily maintained as that in San Saba clay, although in places the surface is more sloping and sheet erosion is more active in unprotected fields.

**Denton clay, shallow phase.**—Denton clay, shallow phase, is characterized by a shallow brown or dark-brown surface soil and a comparatively thin subsoil overlying limestone. The surface soil is brown crumbly calcareous clay, 8 to 10 inches thick. In virgin areas the topmost 2 inches of soil separates on drying to fine and coarse grains, but where cultivated the dry soil is a loose mass of granules to the depth reached by cultivation. The surface soil grades into a subsoil consisting of yellow, yellowish-brown, or brown calcareous crumbly clay. This, in turn, grades below a depth of 15 to 20 inches into disintegrated limestone. The depth to the limestone bedrock varies somewhat, but it is nowhere so slight as to interfere with cultivation. In a few places small areas of Denton stony clay, Denton clay, and the Durant soils are included on the map with this soil.

Nearly all of this soil occurs in the central and southeastern parts of the county, closely associated with other soils of the prairies, particularly Denton stony clay and the Durant and San Saba soils. Most of the areas, which are small and irregular in shape, are cultivated in fields composed largely of the associated soils.

The surface is undulating to gently rolling in most areas. After several years in cultivation, many areas have lost a large part of the surface soil and subsoil through erosion. The generally thin soil, however, is the result of normal erosion before cultivation.

Probably about 45 percent of this soil is cultivated, and the rest is used for pasture. The native vegetation consists principally of little bluestem and a few scattered Osage-orange, winged elm, locust, and oak trees. If the land is not pastured too heavily, a good sod with a luxuriant growth of grass is maintained. In general, corn yields about 20 bushels an acre, cotton one-fourth bale, and oats 30 bushels. About 40 percent of the cultivated land is planted to cotton, 30 percent to corn, 20 percent to oats, and the rest to miscellaneous crops. Erosion has reduced the productivity of many fields. The shallow subsoil affords little reservoir for water, and crops do not withstand long dry periods so well as on deeper soils. For best returns the soil requires careful management for the maintenance of a good supply of organic matter and to prevent erosion.

#### NEWTONIA SERIES

The Newtonia series includes soils with red, reddish-brown, or brown surface soils and red or reddish-brown crumbly clay subsoils. These soils are noncalcareous, although about neutral in reaction, and have developed from limestone on undulating surfaces under a cover of bunchgrasses. These soils are rather productive but are not very extensive in this general prairie area.

**Newtonia very fine sandy loam.**—The surface soil of Newtonia very fine sandy loam is brown or reddish-brown loose very fine sandy loam ranging from 6 to 10 inches in thickness. In virgin areas, because of its organic-matter content, the topmost 4 or 5 inches is darker than the lower part. The subsoil is red heavy but crumbly permeable clay, although in places the upper part is light-red heavy silty clay loam. A few small fragments of partly weathered limestone are present in the lower part of the subsoil. The depth to unweathered limestone is only 24 inches in places, but generally it is more than 3 feet. The surface soil and the subsoil show no response to tests for the presence of acidity or calcium carbonate. In some cultivated areas the very fine sandy loam surface soil is thin because of accelerated erosion. In most places where cultivation has been continued for several years the surface soil is light red or light brownish red.

The land is nearly level to gently undulating, and drainage is good. The principal variations include small areas in which limestone is exposed at the surface or lies within a depth of 12 inches. Areas of this kind are adjacent to areas of Crawford stony loam. Nearly level areas have the most uniform characteristics. Where the surface is slightly rolling or undulating, erosion has removed much of the surface soil and, in places, exposed the heavy red clay subsoil. Here, the limestone material also is at a slight depth.

Probably 98 percent of this soil is now, or has been at some time, under cultivation. At present about 85 percent of the soil is used for the production of crops. It is said that freshly plowed fields have been rather productive, but at present the fertility in many fields has become depleted by intensive cropping without practicing methods of soil improvement or conservation. It is evident that nearly all of the

organic matter in many areas has been removed, and this, together with a probable deficiency of nitrogen, has lowered yields. Erosion also has lowered yields. After several years of cultivation the damages by summer droughts gradually increase. It is reported that the acre yield of corn in many fields cultivated for about 15 years is as much as 10 bushels lower than the yield in freshly cleared fields.

The principal crops grown on this soil are cotton, corn, grain sorghums, oats, cowpeas, and peanuts. If care is used in management of the soil, a large number of crops can be grown successfully. Probably 35 percent of the cultivated land is used for the production of cotton, about 20 percent for corn, 20 percent for grain sorghums, 15 percent for oats, and 10 percent for peanuts and cowpeas. In most fields an average acre yield of one-fourth bale of cotton is considered very good. In years of normal weather conditions, corn yields about 12 bushels, grain sorghums about 20 bushels, oats about 25 bushels, and peanuts about 15 bushels an acre. The vegetation in virgin areas consists principally of several coarse grasses, largely bluejoint turkeyfoot and prairie beardgrass, locally called big and little bluestem, respectively. In places there are scattered growths of elm, Osage-orange, and oak trees. The soil supports a fairly good growth of grasses for pasturage, especially if some attention is given to clearing the land of brush, trees, and weeds, and to the planting of Bermuda grass. A few small areas are used for the production of native-grass hay and Johnson-grass hay.

**Newtonia silt loam.**—The surface soil of Newtonia silt loam is light-red or reddish-brown friable silt loam ranging from 6 to 10 inches in thickness. This passes gradually into a subsoil of crumbly and permeable but moderately heavy red clay. Neither the surface soil nor the subsoil is calcareous, but both are about neutral in reaction. On the sloping higher locations the subsoil rests on limestone at a depth of 2 to 3 feet, and in low places bedrock lies at a greater depth. Small areas are included in which limestone is only 12 inches below the surface. The soil profile is about the same as that of Newtonia very fine sandy loam, except that the texture of the surface soil is slightly finer and heavier.

The land is gently undulating to almost level, and drainage from the surface is free. Underdrainage, although slow, is adequate to provide good aeration of the subsoil throughout. Only a small part of this soil is eroded, and this only moderately. The principal grasses are bluestems and grama. A few trees, chiefly Osage-orange, elm, and oak, grow in scattered places.

Probably 95 percent of this soil is or has been cultivated, although considerable (about 15 percent) is used for hay meadows. In places Johnson grass or Bermuda grass provides good pasturage and hay. Only a small proportion of the soil has been thrown out of cultivation because of severe erosion. The soil is rather productive and is suited to a number of crops. Cotton and corn, the principal crops, occupy about 35 percent of the land. About 20 percent is used for sorghums, and small acreages are used for growing cowpeas and peanuts.

This soil occurs in small areas in the northern part of the county, chiefly associated with Newtonia very fine sandy loam and Crawford stony loam. It is considered one of the most desirable soils of the upland. The virgin soil is about as productive as Newtonia very fine

sandy loam but does not erode so readily or become depleted of plant nutrients so soon. It is reported to retain a higher degree of productivity than Newtonia very fine sandy loam where cropped under similar conditions. According to local information, the average acre yields under normal conditions are: Cotton, one-fourth bale or more; corn, 18 bushels; oats, 25 bushels; and Johnson-grass hay, 1½ tons.

#### DURANT SERIES

Soils of the prairies with brown or grayish-brown surface soils and rather heavy yellowish-brown clay subsoils faintly mottled with gray are members of the Durant series. The surface soils and subsoils are acid and moderately permeable. The surface is smooth to gently undulating, and the soils are deeply developed from clays, shales, or sandstones, all of which are more or less calcareous. These soils have developed under a heavy growth of coarse prairie grasses, and in the virgin condition they contain fairly large amounts of organic matter. These soils are associated with the Denton soils but are more deeply developed from less calcareous parent materials. They are rather productive and are used extensively for the general farm crops.

**Durant silt loam.**—The surface soil of Durant silt loam is dark grayish-brown friable heavy silt loam, about 8 inches thick. In virgin areas the topmost 2 inches of the surface soil is slightly darker than the material below, probably owing to a larger accumulation of organic matter. This grades into yellowish-brown rather heavy but crumbly clay that has faint gray and yellow mottlings in places. Below a depth of 24 to 30 inches the subsoil is very heavy yellow or yellowish-brown clay of alkaline reaction, containing some particles of gypsum and a few concretions of calcium carbonate. The surface soil is rather sharply defined from the underlying subsoil, and in exposed cuts the subsoil has the appearance of a solonetzlike claypan. The surface soil and the upper part of the subsoil are slightly acid and contain fine black concretions. Below a depth of about 48 inches the texture is slightly lighter and the material is more friable. With depth, the yellow coloration decreases and the material is mottled with gray and red or reddish brown. Below a depth of 60 inches the material is gray heavy plastic clay mottled slightly with yellow. This is the parent material of weathered clays and shales with some calcareous sandstones in places. Plate 3, *B*, shows a profile of Durant silt loam.

One of the features of this soil is the irregularity in depth to the heavy claypanlike subsoil. It is rather common for the heavy clay to be within 16 inches of the surface in one place and as much as 30 inches below the surface within a horizontal distance of 10 feet. The friable surface soil is slightly acid in reaction, but the heavy clay subsoil is neutral and appears to contain lime in places in the lower part.

The surface in general is nearly level or very slightly undulating, and drainage is good. Some areas include numbers of scattered low sand mounds. Here, the depth to the subsoil is even more variable than is usual in the typical soil, and in some places the subsoil lies within plow depth. These low mounds disappear after cultivation, and the surface becomes more nearly level. Areas of Durant silt loam range in size from more than 100 to less than 5 acres. A few

bodies are in the southwestern part of the county, but most of the soil is in the central part, where it is closely associated with Durant silty clay loam and Denton clay, shallow phase.

The native vegetation consists chiefly of coarse bunchgrasses, such as bluestems. The soil is well suited to a large number of crops. Corn, cotton, and oats are the principal crops. About 75 percent of the soil is used for the production of cultivated crops, and about 25 percent is used for Johnson- and native-grass pasture. Probably 15 percent of the grass is mowed for hay. Probably not more than 35 percent of the cultivated land is planted to cotton, 30 percent to corn, 15 percent to oats, 10 percent to soybeans, and 10 percent to peanuts and miscellaneous crops. The average yields are moderately high. Although the soil decreases somewhat in productivity after years of cultivation, the yields do not decrease so rapidly as those on the light-colored and light-textured soils of the uplands, or even so much as on many soils of the prairies. Productivity may be maintained easily by keeping a good supply of organic matter in the soil, by growing legumes, such as cowpeas or sweetclover, and by preventing loss of soil moisture and soil material by run-off and erosion.

Probably not more than 5 percent of the area mapped has never been in cultivation, consequently, very little of it is covered by native grass, and practically all the land used for the production of hay has been planted to Johnson grass. Acre yields of Johnson-grass hay and native-grass hay are about 2 tons and 1 $\frac{1}{4}$  tons, respectively. In normal seasons corn produces about 18 bushels an acre, cotton about one-third bale, oats about 30 bushels, and peanuts about 20 bushels. Cowpeas also produce well, and they are valuable for increasing the supply of nitrogen in the soil. Crops do not respond to the increase of nitrogen from the growth of cowpeas, however, so much as they do on the light-textured or sandy soils of the uplands.

**Durant silty clay loam.**—The 10-inch surface soil of Durant silty clay loam is friable dark-brown silty clay loam. Although the 2-inch surface layer is slightly darker than the material beneath, the soil dries to dark grayish brown. This material grades into brown and gray mottled rather heavy clay, containing in places some spots of red and some dark concretions. The gray mottling increases with depth, and below a depth of 30 to 40 inches the color is largely gray with slight mottlings of yellow and reddish yellow. Below the depth of 60 inches the parent material is gray structureless heavy clay mottled with yellow, containing concretions of lime, although the fine earth is not calcareous. The reaction is medium acid to a depth of about 14 inches, but neutral below. The parent materials are largely clay and shaly clay.

Variations in this soil consist of differences in depth to the heavy clay subsoil within a distance of a few yards. The upper heavy clay subsoil has a wavelike appearance, as revealed in road cuts. Small included areas having a clay surface soil are probably Durant clay. These small areas are locally called alkali spots, and probably the soil contains an excess of some salts. In most of these small areas the subsoil material below a depth of 40 inches is strongly alkaline in reaction and crops do not grow well. Most of these areas are along slopes, and where they are one-fourth of an acre or more in size they are generally not cultivated.

The surface is, in general, nearly level or slightly undulating. Ex-

cept in the more sloping areas, most of the rain water penetrates the soil, and the water-holding capacity of the subsoil is large. Crops, therefore, do not suffer from lack of moisture except in periods of prolonged droughts. Plant nutrients are fairly abundant, and most farm crops produce well. In seasons of normal weather cotton produces from one-third to 1 bale an acre, corn about 30 bushels, oats 33 bushels, and peanuts 18 bushels.

This soil occurs in good-sized areas in the central part of the county, closely associated with other Durant soils and with the Denton and San Saba soils. About 70 percent of the soil is used for the production of cultivated crops, and most of the rest is used for the production of wild- and tame-grass hay. About 35 percent of the cultivated land is planted to cotton, 35 percent to corn, 20 percent to oats, and the remainder to peanuts, cowpeas, and miscellaneous crops.

The native vegetation on this soil consists mainly of tall bluestems, but in a few places, particularly in areas having a clay surface soil, the grass cover is chiefly wire grass. Bluejoint turkeyfoot (big bluestem) and Johnson grass produce a luxuriant growth, and high yields of hay are obtained. Acre yields of wild-grass hay and Johnson-grass hay are about  $1\frac{1}{4}$  and 2 tons, respectively. No trees grow on this soil except a few scattered Osage-orange and winged elm.

**Durant-San Saba complex.**—The Durant-San Saba complex consists of a very intricate association of very small areas of both the Durant and San Saba soils, chiefly of clay loam and clay texture. The intimate intermingling of the spots of these soils is indicated in freshly plowed fields by the very spotted appearance of black, brown, and yellow colors of the surface, and in deep roadside cuts where the exposed soil profiles of the different horizons and sharp boundaries between the two profiles are distinctly indicated. The surface of the virgin soil is nearly level to slightly sloping, but a slight micro-relief is produced by small depressions, locally called hog wallows. These depressions are a few feet wide, from 1 to 2 feet deep, and are separated by areas of about equal size, which are flat or slightly higher than the bottoms of the depressions. In the lower positions the San Saba soils of silty clay loam or clay textures are present, and the Durant soils occur on the humps or flats between.

San Saba silty clay loam consists of black slightly acid clay loam, about 12 inches thick, grading into very dark-brown or very dark-gray heavy clay. The subsoil is not calcareous.

Durant silty clay loam consists of brown silty clay loam, ranging in thickness from 2 to 8 inches and grading into brownish-yellow clay with faint gray mottlings. In places the surface soil is so thin that the plow turns up the brownish-yellow subsoil.

These soils appear to be developed from clays or shaly clays of the Lower Cretaceous formations on the prairies in association with the Durant series. In some areas the San Saba soil is more extensive, whereas in others the Durant soil is dominant.

The surface is undulating, and the slopes are gentle. Drainage is good, but in virgin areas water stands in the depressions a short time after rains. With cultivation the hog wallows disappear and the soil takes on the general appearance of Durant silty clay loam.

The native vegetation is rather thick and consists largely of bunch-grasses of species of the *Andropogon* and *Panicum* genera. These

are more abundant in the depressions, whereas the shorter grasses—largely species of *Aristida* and some grama—grow more largely on the spots of Durant silty clay loam.

This complex is not very extensive and occurs in small areas throughout the central part of the county. Probably 20 percent of the land is cultivated, chiefly to corn and cotton, and the rest is used for pasture and cut for hay. Much of the hay is from fields of Johnson grass. Hay yields 1 to 1½ tons an acre, cotton an average of about one-fourth bale, and corn about 15 bushels.

#### CHOCTAW SERIES

The Choctaw series includes soils of the prairies with brown or grayish-brown surface soils and yellow friable subsoils of clay or clay loam slightly mottled with gray, which overlie gray clay and shaly clay with probably some calcareous sandstone interbedded. This parent material is the weathered material of some of the Lower Cretaceous formations. The reaction is acid. These soils resemble the Durant soils in appearance but differ in having much lighter and more friable and permeable subsoils.

**Choctaw very fine sandy loam.**—The surface soil of Choctaw very fine sandy loam is dark grayish-brown very fine sandy loam. In virgin areas the material of the topmost 2- or 3-inch layer is slightly darker and contains more organic matter than the material below. The surface soil grades into yellow friable clay loam or heavy fine sandy loam with slight gray mottlings and fine dark concretions. Below a depth of 20 to 24 inches this grades into heavier material—clay or clay loam—which contains rather more pronounced gray mottling than does the layer above. At a depth of 30 to 40 inches this passes into rather heavy mottled gray and yellow clay. Below a depth of 50 inches the material consists of gray tough clay mottled slightly with brown and reddish brown. The line of separation between the friable upper part of the subsoil and the gray heavy lower part is sharply defined. The surface soil and the upper part of the subsoil are slightly acid in reaction, but the material below a depth of 36 inches is, in most places, neutral. The change in reaction generally occurs at the line separating the friable light-textured material and the tough heavy-textured subsoil material.

Few variations occur in areas of this soil. In places the yellow friable subsoil material is thin and the heavy clay is within 24 inches of the surface, features that approach those of Durant silt loam.

Most areas of this soil are undulating to gently rolling, although some are nearly level. Many areas in the southwestern part of the county and northeast of Boswell contain numerous small sand mounds, which are nearly circular, about 5 feet in height, and from 20 to 50 feet in diameter. The soil on these mounds is somewhat lighter in texture throughout than that in the lower lying areas. The depth to the tough clay subsoil also is somewhat greater. Some of the mounds in cultivated fields are eroded by water and heavy winds. Areas having the dunelike mounds are used principally for hay land.

This soil in places is associated with the Durant soils. The larger bodies and about three-fourths of the total area are in the southwestern part of the county, where some are 3 square miles in size. The rest of the soil, for the most part, occupies comparatively small irreg-

ular and scattered bodies in the central part, in close association with other soils of the prairie lands, particularly the Durant soils.

Probably not more than 15 percent of this soil west of Muddy Boggy Creek is in cultivation. Nearly all of the uncultivated land in this locality is used for pasture or is mowed for hay. About 90 percent of this soil east of Muddy Boggy Creek is in cultivation. About 30 percent of the land in cultivation is used for corn, 30 percent for cotton, 30 percent for oats, and the remainder for miscellaneous crops, including cowpeas, peanuts, and sorgo. These crops produce well except in years of extreme droughts. In seasons of normal weather conditions, acre yields are about one-third bale of cotton, 20 bushels of corn, 30 bushels of oats, and 25 bushels of peanuts. Hay from native grasses, mostly bluestem, has been produced successfully until within the last few years, when yields have rapidly decreased because of droughts and continuous cutting. When attention is given to mowing the weeds and allowing reseeding of grasses, this soil yields about  $1\frac{1}{2}$  tons of hay an acre. Because of the light-textured and friable surface soil and subsoil, sorgo, Sudan grass, grain sorghums, barley, and many vegetable crops yield well in favorable seasons.

#### CROCKETT SERIES

The Crockett series includes soils of the prairies with dark grayish-brown or brown surface soils underlain by red or mottled rather heavy clay subsoils. The mottled colors are red, yellow, and gray, or shades of these. The surface soil and the subsoil are acid. The parent materials here are clays or calcareous clays of formations closely related to those from which the Durant soils have developed. In places these soils appear to have been formed under some forest growth. In this county the Crockett soils are not well represented by typical soils of the series.

**Crockett clay loam.**—The surface soil of Crockett clay loam is brown clay loam, ranging from 4 to 10 inches in thickness and grading into yellowish-red, red, or yellowish-brown rather dense heavy clay that is mottled with gray in the lower part. Below a depth of 10 inches the material has very little structure, closely resembles the parent material, and shows very little soil development. In places thin layers of consolidated shale lie horizontally in the subsoil and are scattered on the surface in many places. The soil is acid in reaction to a depth of about 12 inches. This structureless material is almost impervious, and a large proportion of the rain water does not penetrate the soil. A large amount of surface soil is lost through rapid run-off in nearly all areas that have been cultivated and in the more sloping virgin areas.

Most of this soil is in the southwestern part of the county, but a few small areas occur in the vicinity of Hugo. Most of these bodies border the prairie land and in places support a scattered growth of blackjack oak, post oak, and red oak trees.

A few areas have rather smooth surfaces and gentle slopes, but most of them have rolling surfaces that induce excessive run-off and serious erosion. This soil is locally known as tight land because the surface soil in uncultivated areas packs to a tight mass in dry weather. In

this hardened condition the soil on the slopes does not absorb water readily.

Probably not more than 10 percent of this soil is under cultivation, and the rest is used for pasture. About one-third of the areas formerly cultivated have been abandoned, because of their severely eroded condition, and are used only for the scant pasturage afforded by the native grasses. Virgin areas and those that have not eroded severely afford good pasturage. The native grasses are chiefly bluestems, but in places, especially where erosion is most severe and grazing has been excessive, wire grass is abundant. Nearly all of the cultivated bodies are small and are closely associated with areas of more productive soils. The crops commonly grown are the same as those grown on Choctaw very fine sandy loam and the Durant soils, with which this soil is closely associated. In most favorable seasons the better fields yield about one-fifth bale of cotton, 10 bushels of corn, and 20 bushels of oats to the acre. It seems that this soil would be better suited for pasture. Probably introduced grasses could be used to stop erosion and provide grazing for livestock.

#### DARK-COLORED SOILS OF THE FORESTED TERRACES

The dark-colored soils of the forested terraces are developed from old alluvium on old terraces of the Red River Valley, which lie above overflow. As they have not been above overflow for sufficient time to allow complete development, the soils are not mature. They have formed from alluvium transported largely from the plains and prairies by the Red River and its tributaries. It seems that much of the deeper beds of material lying several feet beneath the surface is material originating from the "Red Beds" formations farther west, but the soil materials above these are largely dark-gray and brown soil materials washed from the dark soils of the prairies in the humid region.

Most of these soils have good drainage, are highly productive, and are very largely used for farm crops. The soils are not calcareous, but they seem to be about neutral or only very slightly acid in the upper part. Originally they supported a forest growth of elm, ash, hackberry, and some oak and pecan trees. These soils do not make up a large part of the county, but, owing to their productivity, they constitute very important agricultural areas. They occur on the terraces on which Teller, Kalmia, and Myatt soils occur, and they are included in the Teller, Lonoke, and Brewer series.

#### TELLER SERIES

The Teller series includes brown or reddish-brown friable surface soils with red or reddish-brown permeable subsoils, developed, under a forest growth of hardwood trees, from old alluvium washed largely from the "Red Beds" of the western plains. These soils differ from the Cahaba soils in that the parent soil material is derived from calcareous materials and the soils are darker on the surface, redder in the subsoils, and more highly productive. These soils are not very extensive, but they are largely in cultivation, as they are very productive and are suited to many kinds of crops. Although these soils are not calcareous, they are not strongly acid.

**Teller very fine sandy loam.**—The surface soil of Teller very fine sandy loam is loose brown or reddish-brown very fine sandy loam, about 8 inches thick, grading into slightly heavier material of reddish-brown very fine sandy loam. At a depth of 12 to 18 inches this material passes into red fine sandy clay or heavy very fine sandy loam. The material becomes increasingly sandy with depth and in places is red or reddish-yellow loamy fine sand below a depth of 3 feet.

Variations in mapped areas include slight differences in texture of the surface soil and subsoil. In areas adjoining the bottom lands the texture of both the surface soil and the subsoil is generally lighter, the surface soil ranging in places from light very fine sandy loam to loamy very fine sand and the subsoil from fine sandy clay to very fine sandy loam. Narrow strips of this variation, extending for the most part in an east-west direction, generally parallel the adjacent flood plains, but in places the areas having porous sandy subsoils occur in small isolated spots.

This soil occurs in scattered areas on the low terrace along the Red River bottoms, associated with areas of the Lonoke and Brewer soils. Many areas are in narrow strips on the low terrace adjacent to the bottom lands or where the surface of the terrace breaks sharply down to that of the low-lying flood plain occupied by the Yahola and Miller soils, about 15 feet lower.

Surface and internal drainage are good. The areas are very gently undulating. This soil occupies slightly higher positions than the Lonoke and Brewer soils and is not overflowed. The soil material is readily permeable, and very little water is lost by run-off. Although the soil holds considerable water, yields are occasionally decreased by long droughts. Crops wilt in late summer in the small areas where the subsoil is unusually sandy.

Probably not less than 90 percent of this soil is cultivated. Cotton and corn are the principal crops, but a small acreage is devoted to grain sorghums and potatoes. The productiveness does not decrease rapidly after several years of cultivation, although many farmers report a noticeable decrease in yields since the land was first cleared. Nearly all areas of this soil were among the first cultivated on the lower terrace along the Red River bottoms. In recent years of normal weather conditions, cotton yields one-third bale and corn about 25 bushels to the acre. This soil is well suited to fruits, vegetables, and other crops, but the plantings are small.

**Teller fine sandy loam.**—The 12-inch surface soil of Teller fine sandy loam consists of reddish-brown loose fine sandy loam. It grades into red fine sandy clay, which becomes increasingly sandy with depth in most places. Below a depth of about 36 inches the material consists of layers ranging from fine sandy clay to loamy fine sand. The principal variation in this soil is the occurrence in small spots of a lighter textured subsoil, generally a loamy fine sand.

This soil occupies only a few small scattered areas on the low terrace adjacent to the Red River bottom lands and is closely associated with Teller very fine sandy loam and the Lonoke soils. Because of the porous and permeable soil material, internal drainage is rapid and very little water is lost by run-off, even during heavy rains. The soil lies above floodwaters of the river.

Probably more than 90 percent of the land is in cultivation, and the rest is covered with forest consisting of post oak, red oak, elm, and some

blackjack oak and hickory. Corn and cotton are the principal crops, but because of the light texture of the soil a larger proportion of cow-peas, peanuts, grain sorghums, and sorgo is planted than on Teller very fine sandy loam. The comparatively low crop yields are due more to the low water-holding capacity of the subsoil material than to the low fertility. In periods of very dry hot weather, most of the crops, especially corn, suffer considerably because of a lack of moisture.

#### LONOKE SERIES

The Lonoke series includes dark crumbly soils of the high terraces lying above normal overflows in stream valleys. These soils are smooth and well drained and have been developed from old alluvium transported mainly from dark soils of the prairies.

**Lonoke very fine sandy loam.**—The 6-inch surface layer of Lonoke very fine sandy loam is dark-brown or brown friable very fine sandy loam. It grades into slightly heavier dark-brown friable very fine sandy loam. At a depth of 12 to 15 inches this material in turn grades into very dark-brown friable silty clay or rich-brown sandy clay loam, which becomes increasingly sandy with depth. In places the clay subsoil contains mottlings or spots of grayish brown and reddish brown in the lower part. Below a depth of 3 feet are thin layers of red or reddish-brown silty clay loam and very fine sandy loam. In some places this deeper subsoil material contains some gray mottling. The soil material for the most part is neutral in reaction, but in places it contains free lime below a depth of 20 inches.

The principal inclusions in this soil as mapped are several areas having slight differences or variations in texture of the surface soil and a few areas with a dark-colored subsoil. Areas having the greatest variations in texture are those within one-half mile of the first-bottom lands. Two areas—one 1 mile southwest of Woodstown and the other in sec. 23, T. 7 S., R. 19 E.—have a very dark-brown or black subsoil below a depth of 30 inches. In many places in these areas internal drainage is slow, and the subsoil is dark grayish brown mottled with gray. Small areas of Lonoke loam and Lonoke silt loam are included with this soil on the map.

This soil occupies a few comparatively small narrow areas in low terrace positions adjacent to the flood plain of the Red River, mostly southeast of Grant and south of Fort Towson, where it is closely associated with the Teller soils and other Lonoke soils. In general, the surface is nearly level, but the presence of low mounds or ridges in places gives the land a slightly undulating relief. Surface drainage and underdrainage are slow but generally adequate for growing crops.

Lonoke very fine sandy loam is well suited to a wide variety of crops but is used mainly for the production of corn and cotton. The surface soil is easily tilled and absorbs water readily. The subsoil, especially the lower part, is sufficiently permeable to allow free underdrainage but is heavy enough to provide a large water-holding capacity. In most years corn yields from 30 to 40 bushels and cotton about one-half bale to the acre. The inherent fertility is high, and the productivity of the soil does not decrease rapidly over a number of years. Up to the present, little effort has been made to maintain fertility, although alfalfa and other leguminous crops grow successfully. In most years alfalfa yields about 3 tons an acre, but in a few areas

bordering first-bottom lands, where surface and internal drainage are more rapid, the yields are somewhat less.

Probably not less than 95 percent of this soil is in cultivation. About 10 percent of the cultivated land is devoted to alfalfa, potatoes, cowpeas, and a few other crops, and the rest is planted to corn and cotton. The land originally supported a growth of red oak, elm, post oak, pecan, and a few other trees. On the small areas of associated Lonoke silt loam potatoes are grown and yield from 200 to 300 bushels an acre; cotton yields as much as three-fourths bale, corn 40 bushels, and alfalfa 4 tons.

**Lonoke silty clay loam.**—The surface soil of Lonoke silty clay loam is dark-brown friable silty clay loam, ranging from 6 to 12 inches in thickness, grading into dark-brown heavy silty clay loam, which, below a depth of 24 inches, grades into brown loam, sandy clay loam, or mottled gray and yellow clay. The material in the subsoil is heavy but comparatively friable and permeable. Below a depth of 38 inches the material is gray, yellow, or light reddish-brown friable very fine sandy loam, which, in places below a depth of 50 inches, becomes increasingly red and sandy with depth and in many places includes alternating layers of red material of several textures. In most places both the surface soil and the subsoil are neutral in reaction. In the more poorly drained places the subsoil below a depth of 24 inches contains concretions of lime.

The principal variation of this soil is a slightly darker colored and heavier textured surface soil in depressed locations. Here, surface drainage is slow, and the subsoil has a distinct gray color or mottling. These areas, as well as a few areas of Lonoke very fine sandy loam, are too small to be shown separately and are included with Lonoke silty clay loam on the map. Near the areas of Teller soils the subsoil in places is mottled with red or is reddish-brown clay below a depth of 20 inches.

Areas of this soil lie on the low flat terrace in the Red River Valley several feet above the flood plains. They are closely associated with areas of Teller soils and other Lonoke soils and are scattered and irregular in shape. They range in size from 10 to 600 acres. This soil occurs in small areas between Muddy Boggy Creek and the Red River near their junction, southeast of Grant, and south of Fort Towson.

The land is prevailingly flat. Surface drainage is slow, and in many places during an unusually wet season drainage is so deficient as to injure crops. The land does not receive overflow water from adjoining areas, and good results are obtained by surface drainage ditches.

In most years this is the most productive soil of this group for cotton and corn, and probably not less than 80 percent is devoted to these crops. A slightly greater acreage is planted to cotton than to corn. Cotton yields from one-half to three-fourths bale, and corn from 40 to 50 bushels to the acre. The acreage of alfalfa has increased considerably in the last few years, and at present about 10 percent of the soil is devoted to this crop, which produces from 4 to 6 tons an acre in years of normal weather conditions. This soil is retentive of moisture, and yields, especially of cotton, are greater in drier than in wetter seasons. During the prolonged rainy periods in late spring and early summer, rain water drains off slowly and re-

mains for some time in the shallow sags and swales. In these places alfalfa is often damaged, and it becomes necessary to reseed the crop. Open drains have improved drainage conditions in places where these have been constructed.

In freshly cultivated areas this soil has a large supply of plant nutrients, which are not dissipated rapidly by intensive cultivation. At present little effort is made to replenish the supply of plant nutrients except in a few places by growing alfalfa. Yields of cotton and corn, however, have decreased somewhat in the last few years in the older cultivated areas, and some attention is being given to replenishing the supply of organic matter. Very little commercial fertilizer has been added.

The native tree growth consisted of post oak, water oak, red oak, elm, hackberry, and some hickory and pecan, but at present very little of the land—probably less than 2 percent—is forested.

**Lonoke clay.**—The 6- to 12-inch surface layer of Lonoke clay is dark-brown moderately friable clay. It grades into dark-brown heavy clay, which grades, in turn, into reddish-brown structureless clay or silty clay at a depth ranging from 24 to 36 inches. In places a slight gray mottling is present and increases with depth. At a depth of 40 inches the material passes into grayish-brown clay mottled with gray and reddish brown. The soil is neutral in reaction, and in most areas concretions of lime lie within 18 inches of the surface. Organic matter is abundant in the surface soil, and in most places the organic matter penetrates to a depth of 20 to 24 inches, forming dark streaks and spots in the lower part of the subsoil.

Except for local differences in the thickness of the dark-colored surface soil, this soil is fairly uniform. Inclusions are mainly small areas in which the surface soil is very dark brown or very dark grayish brown and the subsoil is grayish brown mottled with gray. In a few small areas included on the map with this soil in the vicinity of Grassy Lake southwest of Woodstown and south of Muddy Boggy Creek in secs. 17, 20, and 21, T. 7 S., R. 16 E., a soil occurs in which the 8-inch surface soil is reddish-brown heavy clay, which grades into a red heavy clay subsoil. In these places the material in the surface soil and subsoil effervesces with acid, and concretions of lime are in the upper part of the subsoil. Freshly plowed fields in such areas appear distinctly red. This soil is of a different series and would have been so recognized if its total area had been greater.

Lonoke clay occurs in widely scattered irregular areas on the low Red River terrace southeast of Soper, southeast of Grant, and south of Fort Towson. They range in size from about 880 to less than 5 acres. The largest body is south of Soper. The surface is nearly level, and surface drainage is slow, particularly in the larger areas and in the smaller slightly depressed areas. Because of the heavy surface soil and subsoil, water penetrates slowly, and in most places it remains on the surface for some time after heavy rains. Many areas of this soil are artificially drained by ditches.

This soil is productive, and good yields of cotton and corn are obtained, provided the season is not too wet. Because of a tendency of the heavy clay to bake and crust on drying and the necessity of deeper cultivation, more power is necessary for plowing and cultivating this soil than for the lighter textured soils of this group. This

soil is plastic when wet and cannot be cultivated at such times. It has a tendency to clod if plowed when too wet or too dry, but the clods generally break down on exposure and the soil forms a tilth favorable for plant growth. With favorably distributed moisture, the soil works well and a good seedbed is obtained.

About 80 percent of this soil is cultivated. Probably not less than 55 percent of the cultivated land is planted to cotton, about 35 percent to corn, 5 percent to alfalfa, and the rest to miscellaneous crops. Crops withstand droughts well, and even in years when the rainfall is below normal the large amount of moisture stored during the winter generally assures a good crop. In years of normal weather conditions cotton yields from one-half to three-fourths bale an acre, corn about 40 bushels, and alfalfa from 3 to 4 tons. Alfalfa produces well and maintains a stand if the lower areas are sufficiently well drained to prevent water from standing on the surface for more than a day or two.

Nearly all of the uncultivated areas are poorly drained and are covered with trees, mainly elm, post oak, water oak, and some hickory. The original forest has been cut-over, and the present growth has little value except for firewood.

#### BREWER SERIES

The Brewer series includes dark-colored soils developed from old alluvium occupying terraces that lie high above overflow. The soil materials are derived chiefly from dark soils of the prairies in the humid region.

**Brewer silty clay loam.**—The surface soil of Brewer silty clay loam, in virgin areas, is dark grayish-brown silty clay loam, about 12 inches thick. It grades into gray or dark grayish-brown silty clay or clay, which in places has a slight mottling of brown. The surface soil and the subsoil are neutral in reaction, but a few concretions of lime occur within a depth of 20 inches. The surface soil seems to contain a large amount of organic matter. The subsoil material is rather plastic when wet and becomes very hard when dry.

Few variations are included in mapped areas of this soil. The soil occurs on low terraces of the Red River Valley, mostly adjacent to the sandy upland. These areas, where influenced by local wash from sandy lands, have a 1- or 2-inch surface layer of lighter textured material ranging from very fine sandy loam to clay loam. A fairly large area mapped as this soil in sec. 5, T. 8 S., R. 18 E., has a very dark subsoil.

This soil is closely associated with areas of Lonoke soils. A few areas are on a low terrace adjacent to the Red River bottom lands south of Soper, but most of the areas are scattered on the low terrace southeast of Grant and south of Fort Towson. This soil occupies swags and more poorly drained places on the terraces. Natural drainage is very poor, and water stands on the surface during the winter and in some years until midsummer. The surface of nearly all areas can be drained by open ditches. At present about 40 percent of the soil has been drained artificially, and about 70 percent has sufficient natural and artificial drainage to produce crops.

This soil is considered best suited for the production of cotton and corn. About 55 percent of the cultivated land is planted to cotton, 35 percent to corn, and the rest to alfalfa. In seasons when the rainfall

is not excessive, cotton yields from one-half to three-fourths bale and corn from 30 to 40 bushels an acre. Although the heavy subsoil does not allow free passage of water, it absorbs a large amount of water during and after rains. Because of slow drainage and the large water-holding capacity of the subsoil, crops do not suffer from lack of water during prolonged droughts. In the better drained areas the yields of alfalfa are high, once a good stand is obtained, generally ranging from 4 to 5 tons an acre. Because of poor drainage and the tendency of the surface soil to bake on drying, it is difficult to prepare a good seedbed, particularly for alfalfa. Deep cultivation has proved beneficial, and the heavy surface soil makes necessary considerable power for operating farm implements. About 60 percent of this soil is in cultivation, and the rest supports a thick forest growth of post oak, water oak, hackberry, hawthorn, elm, and some hickory and black walnut.

#### LIGHT-COLORED ACID SOILS OF THE BOTTOM LANDS

Light-colored acid soils of the bottom lands range from gray to brown. They are largely sandy and loamy in texture, because the soil materials have been transported by floodwaters mainly from forested areas in the humid region where the soils are sandy. Overflows occur occasionally, and in some places water stands on the surface for a considerable time on account of poor drainage. Where drainage conditions are favorable, a considerable amount of the land has been cleared and is cultivated. The soils are moderately to highly productive. In uncleared areas the native tree growth includes several species of oak, ash, elm, hackberry, river birch, gum, and other trees. The soils are probably lower in inherent fertility than the other soils of the bottom lands, because the soil materials are derived largely from leached soils of the uplands that have a high content of siliceous matter. The soils included in this group are of the Ochlockonee, Bibb, Atkins, and Pope series.

#### OCHLOCKONEE SERIES

The Ochlockonee series includes soils having gray or grayish-brown surface soils with gray or light-brown subsoils. The surface soils and the subsoils are acid and contain considerable organic matter. These soils have good surface drainage and underdrainage in most places but are occasionally overflowed. They are cleared and cultivated and produce good yields of various crops. They occur chiefly along the small streams that drain the light-colored sandy soils of the forested uplands.

**Ochlockonee very fine sandy loam.**—The surface soil of Ochlockonee very fine sandy loam is brown or light grayish-brown very fine sandy loam, ranging from 6 to 12 inches in thickness. It grades into brown or yellowish-brown heavy very fine sandy loam. Beginning at a depth of 2 to 3 feet, this material becomes increasingly sandy or coarser, ranging from fine sandy loam to loamy fine sand. The soil is acid throughout.

As this soil occurs largely in small areas in narrow valleys receiving additional sediments from locally eroded uplands, it includes considerable variations from place to place in the surface soil and subsoil, depending on the force and volume of the floodwaters depositing

the materials. In places the surface soil and the subsoil contain much more silt and clay than in other places. Variations in sand content and colors of the subsoil are due to local differences of deposition and drainage. In places the subsoil is mottled with gray. A few inclusions of small areas of loam, silt loam, and loamy fine sand are made in mapping where these areas are too small to show separately.

This soil is rather permeable throughout, and as a rule drainage from the surface and beneath is favorable for plants during the growing season. The water table is not sufficiently high to prevent good internal drainage, and the soil holds a good reserve of water for growing crops.

The land is smooth and low lying. Occasionally it is overflowed during the crop-growing season, but ordinarily damage from this source does not prevent successful production. In places drainage is deficient, and some areas have been given better drainage by ditching. Many trees common to the general group of alluvial soils grow on the uncleared areas. Although most areas of the soil are small and occupy narrow strips along numerous small streams, these areas total a rather large acreage for the county. This soil borders the smaller streams throughout the light-colored forested sandy uplands.

This soil is productive and suited to many crops. Yields do not decrease rapidly under intensive cultivation, partly because of fresh soil materials added by occasional inundations of floodwaters. As a rule the areas are long and narrow and are not sufficiently large to cover an entire farm, but the narrow bodies represent a valuable part of many farms where much of the other land is of decidedly lower productivity. Probably about 20 percent of the soil is cultivated. About 60 percent of the cropland is planted to corn, 25 percent to cotton, 10 percent to grain sorghums and sorgo, and the rest to sweet-potatoes, vegetables, and other crops. Corn yields from 25 to 35 bushels an acre, cotton from one-third to two-thirds of a bale, and grain sorghums about 40 bushels. In many of the areas grain sorghums, sorgo, and other quick-maturing crops are planted because of overflows in late spring and early summer. Most of the sorgo grown for sirup is produced on this soil, and a large proportion of the sugarcane for sirup also is grown along Gates Creek and other streams north of Fort Towson. It is reported that sugarcane produces from 150 to 250 gallons of sirup to the acre.

Good pasture is obtained on much of this soil, even with native grasses. Most areas, especially those in the southern part of the county, support a thick cover of Bermuda grass. This grass, together with some clover, is highly desirable for pasturage. About 40 percent of the uncleared land has a thick forest cover, and here the grass cover is comparatively thin.

**Ochlockonee clay loam.**—The surface soil of Ochlockonee clay loam to a depth of 4 inches is dark grayish-brown clay loam containing considerable organic matter. It grades into grayish-brown or brown clay or clay loam, which, below a depth of 16 inches, passes into grayish-brown loamy fine sand or fine sandy clay loam, mottled with gray. This material continues to a depth of several feet. The surface soil is friable when moist, is moderately sticky and plastic when wet, and on drying becomes rather hard and massive. The soil is acid in reaction.

Small areas of Ochlockonee very fine sandy loam and Ochlockonee loamy very fine sand are included with this soil on the map. The most typical areas of Ochlockonee clay loam are back from the stream channel and close to the edge of the upland, where drainage is deficient in many places.

The surface is flat except along the stream channels, where, in most places, recently deposited alluvium forms natural levees. Although areas of this soil are not often flooded, they remain excessively wet most of the year because of poor drainage and seepage of water from the higher lying soils. Where the areas are wide, drainage conditions are generally poorer and the soil is in a soggy and wet condition during winter and spring. This soil is not extensive and occurs in widely scattered narrow areas along streams originating in the deep sandy soils in the northern part of the county. Most areas are west of Nelson and near Hamden School.

Owing to the wet condition of the soil, probably less than 5 percent is cultivated. Most areas support a thick cover of coarse grasses, but in places a thick tree growth consists of water oak, willow oak, tupelo (black gum), sweetgum, sycamore, post oak, red oak, dogwood, and shrubs.

#### BIBB SERIES

The Bibb series includes gray or very light grayish-brown soils with gray or mottled subsoils. They comprise low flat areas of alluvium that have very deficient drainage, both from the surface and beneath, and a high water table. During the winter and spring these soils remain saturated for months. They consist of sediments from the light-colored leached forested soils of similar character as those giving rise to the Ochlockonee soils, but they differ from those soils chiefly in their more deficient drainage. The forest growth is composed more largely of water-tolerant trees, including water oak, willow oak, gum, river birch, and red maple (water maple). These soils are generally too poorly drained for use for farm crops, and they are strongly acid throughout.

**Bibb very fine sandy loam.**—The 8-inch surface soil of Bibb very fine sandy loam is grayish-brown very fine sandy loam. It grades into light grayish-brown or gray very fine sandy loam mottled with brown and yellow. The subsoil becomes lighter colored with depth and, as a rule, more mottled. In places it is clay or clay loam below a depth of 2 feet. This layer contains a few small black concretions. Below a depth of 30 inches in many places the subsoil or substratum is gray loamy very fine sand mottled with brown and grayish brown. This material becomes increasingly heavy textured with depth and changes to gray fine sandy clay below a depth of 42 inches. The surface soil ranges from very loose and light to very silty.

This soil occurs along small streams throughout the sandy uplands. Most of the areas are north of Sawyer, near the county line north of Hugo, and east of Grant.

The land is low, flat, and fairly uniform in surface features. It is locally called crawfish land and is considered undesirable for the production of crops. Natural drainage is very poor, and the soil is very wet most of the year. Probably less than 5 percent of it is cultivated. Most of the cultivated areas are artificially drained and are used largely for the production of sorgo and grain sorghum. With proper drain-

age, cotton yields about one-fourth bale an acre, corn about 10 bushels, and grain sorghum about 20 bushels.

This soil supports a thick forest growth of water oak, willow oak, tupelo, sweetgum, birch, red maple, and other trees. The grass cover is thin in most places and consists of coarse grasses.

#### ATKINS SERIES

The Atkins series comprises very flat poorly drained gray soils in flood plains of streams that drain the sandy and shaly soils and formations of the Ouachita province, and the soils consist of sediments washed mostly from the thin leached eroded soils in that physiographic province. These soils contain a moderate amount of organic matter and are acid throughout. Their productivity is only moderate, and because of generally deficient drainage conditions they are not used for crops very extensively. They support a heavy forest growth of water-tolerant trees, including elm, ash, water oak, willow oak, sweetgum, and others.

**Atkins silt loam.**—The surface soil of Atkins silt loam is gray or light grayish-brown silt loam without distinct structure. In virgin areas a large quantity of leafmold darkens the soil to a depth of about 1 inch. The surface soil grades into gray silty clay mottled with brown, which, below a depth of about 22 inches, gives way to mottled yellowish-brown and gray rather tough almost impervious heavy clay. This material continues to a depth of several feet. A good tilth may be obtained when the surface soil is moist, but this material becomes rather compact when dry. The surface soil is acid in reaction, but the subsoil below a depth of 24 inches is neutral in many places.

This soil occurs on nearly level high bottoms bordering the Kiamichi River in the northeastern part of the county. Although it is inundated only occasionally by floodwaters from the Kiamichi River, very deficient surface and internal drainage and run-off from adjacent areas keep the soil wet most of the winter and spring. Very little attempt has been made to drain the land artificially.

A large part of this soil has been in cultivation, but at present probably less than 15 percent is cultivated. The soil is probably rather low in plant nutrients, and when it is cultivated the yields are low even in places where drainage is adequate. Most of the year the soil is either too soggy and wet for the production of crops or too tightly packed when dry for easy cultivation. As the soil dries, large, deep cracks form, which allow the loss of moisture by evaporation. Cotton is the principal crop, and probably not more than 25 percent of the cultivated land is devoted to other crops. In seasons of favorable weather conditions cotton yields about one-fifth bale and corn about 10 bushels an acre.

This soil supports a thick forest growth of cedar elm, water elm, hackberry, willow oak, sweetgum, water oak, willow oak, hawthorn, and other trees. Pasturage is very poor because of the scant covering of grass.

**Atkins silt loam, high-bottom phase.**—The 8-inch surface soil of Atkins silt loam, high-bottom phase, is grayish-brown or gray silt loam without distinct structure. This grades into light grayish-brown or gray heavy clay slightly mottled with brown and yellow, and below a depth of 18 inches this in turn grades into gray heavy tough

clay mottled with brown. The subsoil material is heavy and compact, and water does not readily penetrate it. A 1- to 2-inch surface layer in virgin areas contains some organic matter. Following cultivation, this material becomes mixed with the underlying gray material, and in a few years the organic matter is dissipated. The surface soil and the subsoil are acid in reaction.

This soil is not extensive. It is closely associated with other Atkins soils along the Kiamichi River. Overflows occur occasionally. This soil lies slightly above the soils of the surrounding bottom lands. Natural surface drainage is good, but internal drainage is slow.

Approximately 60 percent of the land is cultivated, mostly to cotton. Because of the small content of available plant nutrients, especially nitrogen, crop yields are low. In favorable seasons cotton yields about one-fifth bale and corn about 12 bushels an acre. Favorable tilth may generally be obtained, but the water-holding capacity apparently is not high, so that crops suffer quickly in very dry seasons. Most of the land is used for pasture. The tree growth consists largely of sweetgum, post oak, red oak, and hickory.

**Atkins silty clay loam.**—In virgin areas the 1-inch surface layer of Atkins silty clay loam is gray or grayish-brown silty clay loam containing considerable organic matter. It is underlain by a 9-inch layer of gray silty clay loam with rust-brown mottling. This material grades into gray silty clay containing spots and streaks of brown and yellowish-brown material. Below a depth of 20 inches is gray heavy very compact brittle clay mottled with brown. Both surface soil and subsoil are compact and hard when dry and allow very slow penetration of water and air. They are acid in reaction.

This soil occupies large areas on the flood plain of the Kiamichi River. It is made up of soil materials washed from the shale and sandstone soils and formations of the Ouachita province. The areas have a flat surface and are subject to occasional overflows. Natural drainage is very poor. Water covers the surface most of the winter and spring, but during the summer the soil is dry and hard.

About 15 percent of the soil has been cleared of its forest growth, but less than 5 percent is cultivated at present. Owing possibly to a small amount of plant nutrients and the difficulty in obtaining a good tilth, as well as to deficient drainage, crop yields are unsatisfactory. Where the land has been artificially drained and planted to Bermuda grass, good pasturage is obtained. The forest growth consists of a heavy cover of elm, water oak, post oak, hackberry, ash, sweetgum, tupelo or black gum, willow oak, hickory, hawthorn, and various other trees.

#### POPE SERIES

Members of the Pope series have brown acid friable surface soils and light-brown or yellow permeable crumbly subsoils. These soils occupy the better drained parts of the flood plains of streams that drain the sandstone and shale soils of the Ouachita province. They are associated with the Atkins soils but occupy better drained situations. are browner, and are more productive. The native forest includes hackberry, red maple, sweetgum, hickory, ash, and some species of oak.

**Pope fine sandy loam.**—The surface soil of Pope fine sandy loam is brown fine sandy loam, ranging from 10 to 15 inches in thickness. This is underlain by brownish-yellow fine sandy loam or loam, which

becomes increasingly sandy with depth. In most places the light-textured subsoil material continues to a depth of several feet, but in some places alternating layers of light- and heavy-textured material occur below a depth of 20 inches. In some places the texture of the surface soil is rather variable. Areas indicated as this soil on the map include small patches and narrow strips of Pope very fine sandy loam and Pope loamy fine sand.

Most of this soil borders the Kiamichi River and is subject to frequent overflows, although drainage otherwise is fairly good. Ridges of recently deposited alluvial material make the surface undulating and hummocky. Frequent overflows from the river prevent the successful production of crops except in a few areas. Probably not more than 5 percent of this soil is cultivated. Corn is the principal crop, and some cotton is grown. In favorable seasons corn yields about 20 bushels and cotton about one-third bale an acre.

A heavy forest cover and frequent overflows discourage the growth of grass, and very little pasture is afforded. The trees are largely hackberry, elm, post oak, ash, water oak, willow oak, sweetgum, and water hickory.

**Pope loamy fine sand.**—The surface soil of Pope loamy fine sand is brown or light-brown loamy fine sand, about 18 inches thick. It grades into yellowish-brown loamy fine sand, which continues to a depth of several feet, although in many places the subsoil consists of layers of various thicknesses and textures. Both the surface soil and the subsoil are slightly acid in reaction. Small bodies of Pope very fine sandy loam and Pope loamy very fine sand are included with this soil as mapped.

Pope loamy fine sand occurs mostly along the channel of the Kiamichi River in the northern part of the county and is subject to frequent overflow. The surface is hummocky and rolling, owing to numerous ridges extending parallel to the channel. Because of the frequent overflows, probably less than 5 percent of the soil is cultivated. Corn and cotton are the principal crops. Corn yields about 12 bushels and cotton about one-fifth bale an acre.

This soil supports a growth of trees consisting mainly of hackberry, maple, gum, and some species of oak. The growth of grass is scant, and the land is not very good for pasture.

#### DARK-COLORED SLIGHTLY ACID SOILS OF THE BOTTOM LANDS

The dark-colored slightly acid soils of the bottom lands include dark-brown, dark-gray, and black soils that are more or less acid and consist of soil materials in the flood plains of streams that originate in or drain considerable areas of dark soils of the prairies, such as those of the Durant, San Saba, Choctaw, and Denton series. These soils occur more generally along Muddy Boggy and Clear Boggy Creeks, which drain large areas of prairie lands in central Oklahoma, and streams draining the local prairie lands. All these soils are subject to overflow. In many places, however, natural drainage is adequate for successful cultivation, and in such places the soils are used extensively for the general farm crops. These soils are of the Verdigris, Pulaski, Kaufman, and Osage series. The Pulaski soils as occurring in this county are not representative of the group but are included because they are associated in the same general areas.

## VERDIGRIS SERIES

The Verdigris soils have brown to dark-brown surface soils over brown or gray subsoils. They are composed of soil materials transported largely from dark soils of the prairie in central Oklahoma. They are inherently productive, and, where drainage is favorable, crops yield well. These soils occur chiefly along Muddy Boggy and Clear Boggy Creeks. They support a heavy forest growth of hackberry, ash, sycamore, water oak, pecan, and other trees.

**Verdigris very fine sandy loam.**—The 12-inch surface soil of Verdigris very fine sandy loam is dark-brown or brown friable very fine sandy loam. This grades into an 18-inch layer of light-brown or grayish-brown silty clay loam, which in turn grades into brown very fine sandy clay, in places mottled with gray and red. Below a depth of 48 inches the material is gray or brownish-red fine sandy clay of slightly lighter texture than the material above. Although the subsoil is rather heavy, it is readily permeable. It has a large water-holding capacity and carries a good reserve of soil moisture for use in dry seasons. With continued cultivation the soil becomes slightly lighter in color. Both surface soil and subsoil are almost neutral, but in a few places the surface soil is very slightly acid in reaction.

Areas of Pledger very fine sandy loam along the Kiamichi River, south of Fort Towson in secs. 8, 9, 10, and 11, T. 7 S., R. 19 E., are included with this soil on the map, owing to their small total extent. Other included small areas are chiefly Verdigris silty clay loam, and narrow strips along drainage channels are Verdigris loamy very fine sand. The red color of the lower part of the subsoil of Verdigris very fine sandy loam in some places is not typical of the Verdigris soils and is probably due to inclusions where the typical soil is underlain by earlier deposits of sediments from backwater of the Red River or from some other local source of eroded red soils.

This soil occurs along the Kiamichi River, Muddy Boggy Creek, and smaller streams issuing from large areas of soils of the prairie land. The surface in most places is nearly level, but natural surface drainage and underdrainage are good. In some places the surface is slightly undulating, with a slope toward the drainage channels that meander across the bottom land. Artificial drainage is unnecessary and damage to crops by overflow is rare, because of the free drainage.

This is one of the most extensive of the very productive soils of the bottom lands, and probably not less than 90 percent of it is cultivated. About 55 percent of the cultivated land is planted to corn, 35 percent to cotton, and the rest to grain sorghums, sorgo, and other miscellaneous crops. Corn yields an average of about 35 bushels an acre, cotton one-half bale, and grain sorghums 40 bushels. Potatoes, sweetpotatoes, and vegetables also yield well. Uncleared areas of this soil support a tree growth consisting chiefly of hackberry, elm, red oak, post oak, black walnut, pecan, hickory, and sycamore.

**Verdigris silty clay loam.**—The surface soil of Verdigris silty clay loam is dark-brown or grayish-brown silty clay loam from 10 to 15 inches thick. It grades into light-brown or grayish-brown clay. The material in these two layers is comparatively heavy but is sufficiently friable and porous to allow easy penetration of water, air, and roots. Below a depth of 2 feet gray mottlings are present. In places where the soil occurs in valleys joining the Red River Valley, the sub-

soil is red, probably because of old red soil materials, which were deposited from backwaters of the Red River prior to the more recent deposition of the dark material. The soil is well supplied with organic matter and plant nutrients, and, owing to its large water-holding capacity, crops are well supplied with moisture. Both surface soil and subsoil are neutral to slightly acid in reaction.

The surface is flat to undulating, and in many places drainage is poor, but on the whole the land has adequate drainage for successful cultivation. Most of the areas are in the bottom lands along Muddy Boggy Creek and along the Kiamichi River southeast of Sawyer, but a few areas are along Mayhew, Bee, and Bokchito Creeks and other small creeks. All the land is subject to overflow one or more times a year, but crop losses rarely occur oftener than once in 4 years. Alfalfa is often damaged by overflows in winter and early spring.

On the more poorly drained bottom lands the uncleared areas support a native growth of elm, ash, hickory, hackberry, Osage-orange (bois d'arc), walnut, and water oak. Probably 90 percent of this soil is in cultivation. Most of the cultivated land is devoted to corn and cotton, and about equal acreages are planted to these two crops. The productivity of this soil does not decrease rapidly, because additional plant nutrients are frequently supplied by fresh alluvium deposited by overflow waters. During favorable seasons—that is, when crops are not damaged by overflow—cotton yields from one-third to three-fourths of a bale and corn from 30 to 50 bushels an acre.

#### PULASKI SERIES

The Pulaski soils are characterized by brown surface soils and brown or yellowish-brown subsoils. In this county these soils are associated with the Verdigris soils and are composed largely of soil materials washed from sandy soils of the prairies and forested uplands. The reaction is slightly acid to neutral. Here and there in the valleys entering the Red River Valley red materials occur in the lower part of the subsoils. They were deposited by backwaters of the Red River overflows before the sedimentation of the brown materials that now constitute the surface soils.

**Pulaski loamy fine sand.**—The surface soil of Pulaski loamy fine sand is dark-brown or brown loamy fine sand, ranging from 2 to 10 inches in thickness. It is underlain by a 26-inch layer of light-brown heavy loamy fine sand. In cultivated areas the surface soil is mixed with the material below and the 6-inch surface soil is loamy fine sand. Below a depth of 28 inches or more the material grades into reddish-brown clay mottled with gray. The entire soil is neutral in reaction.

Most of the inclusions are small spots of Verdigris very fine sandy loam. In many places the thick subsoil layer contains some sand, but the texture is in few places lighter than fine sandy clay. Although the texture of the surface soil is rather light, the subsoil holds a large supply of moisture and crops do not often suffer from droughts. Some areas along Clear Boggy Creek have a subsoil of grayish-yellow fine sand.

This soil is of very slight extent. It occupies very small widely scattered areas along the Kiamichi River southeast of Sawyer, along Muddy Boggy Creek, and along Clear Boggy Creek, and a few bodies border other small streams. The material of this soil is composed of

alluvium washed from the soils of the prairies. Most of the areas are narrow long strips adjacent to the stream channels and are subject to frequent overflow.

Probably less than 10 percent of this soil is cultivated. Some cotton is grown, but about 75 percent of the cultivated land is planted to corn. In seasons in which the crops are not damaged by overflow cotton produces about one-third of a bale and corn about 30 bushels an acre. Potatoes, sweetpotatoes, and vegetables also produce well. The native forest growth consists of elm, red oak, post oak, white oak, black walnut, pecan, hawthorn, and hickory.

#### KAUFMAN SERIES

The Kaufman series includes dark-gray to black soils on the alluvial flood plains of streams draining the dark soils of the prairies. Materials washed from such soils as the San Saba and Denton make up the soils. The reaction is acid to neutral. These soils are deep, of high inherent fertility, and, where drainage is adequate, highly productive. They support a heavy forest growth of several species of oak, hackberry, elm, and other trees.

**Kaufman clay.**—The surface soil of Kaufman clay is dark-brown clay, about 10 inches thick, grading into grayish-brown waxy clay that becomes lighter colored with depth. The lower part of the subsoil ranges from dark gray to gray. Yellowish-brown or red mottlings appear in places below a depth of 20 to 30 inches. Organic matter is abundant, and in places the soil is almost black. Although the soil is heavy textured, it crumbles to a friable condition when plowed under proper moisture conditions. The subsoil allows slow penetration of water downward, but where surface drainage is good the subsoil does not remain saturated very long. Both the surface soil and the subsoil are slightly acid to neutral.

In places red or reddish-brown clay forms the lower part of the subsoil from 20 to 30 inches beneath the surface. This material represents older sediments deposited by floodwaters carrying red soil materials.

The surface is practically level, and the broad, smooth bottoms lie several feet above the stream beds. Drainage is largely very slow because of the flat surface and the very slowly penetrable heavy clay subsoil. Overflows occur occasionally, and the water stands in places for a long time. The surface soil and the subsoil in large areas remain saturated most of the winter and spring. The native vegetation consists of a heavy growth of large trees, principally elm, hackberry, ash, and several species of oak.

This soil occurs mostly along Muddy Boggy and Clear Boggy Creeks and is the most extensive alluvial soil of the county. Owing to inadequate drainage, only about 20 percent is in cultivation. About 90 percent of the cropland is devoted to corn and cotton, which are grown on about equal acreages. Good yields are obtained when seasons are favorable and overflows do not occur. Rains in early spring often retard the growth of crops, and in very dry seasons crops suffer from the hard-packed and cracked condition of the soil. Under favorable conditions cotton yields about three-fifths bale and corn 40 bushels an acre.

## OSAGE SERIES

The Osage series includes very dark soils composed of alluvial materials on the flood plains along streams that drain dark soils of the prairies, such as the San Saba, Durant, and Denton. These soils are crumbly and noncalcareous, although in places a few fine particles of limestone are in the soils. The forest growth consists chiefly of oaks, elms, hackberry, and other trees. These soils are much like the Kaufman soils in better drained areas but are somewhat darker, less acid, and better drained.

**Osage clay.**—Osage clay consists of black clay, about 12 inches thick, underlain by dark-brown slightly friable crumbly clay. The subsoil material becomes increasingly lighter colored with depth and at a depth of 42 inches is light-brown or grayish-brown clay. Although the surface soil is heavy, it is rather friable, and good tilth is obtained when the soil is cultivated under favorable moisture conditions. Generally the entire soil is noncalcareous, but in places it effervesces with hydrochloric acid, owing mainly to the small fragments of limestone present in many places.

In places small areas of Osage clay loam are included with this soil on the map. Most of these areas are irregular in shape and intricately associated with the larger areas of clay. Another variation includes small areas in which limestone bedrock lies at a depth ranging from 36 to 50 inches beneath the surface.

Areas of this soil border streams that drain the prairies. The surface is very nearly level, and both internal and surface drainage are slow. Overflows are frequent, but in most places water drains off in a short time so that crops are rarely damaged. Although a few areas have been drained artificially, many areas, especially most of the uncultivated ones, could be made suitable for crop production by straightening the stream channels and digging lateral drainage ditches.

This is one of the most productive soils of the county. It has a large supply of plant nutrients, particularly nitrogen, also a large amount of moisture, and it is well suited to the production of corn and cotton. It is also well suited to alfalfa, provided the land is sufficiently well drained to prevent floodwaters from standing on the surface for long periods. In most years corn yields about 40 bushels and cotton about three-fifths bale an acre. About 70 percent of the soil is cultivated, and the rest supports a scattered growth of elm, Osage-orange, black walnut, pecan, blackjack oak, post oak, and redbud trees. Most of the cultivated land is planted to cotton and corn, with a little more than half being devoted to corn.

## CALCAREOUS SOILS OF THE BOTTOM LANDS

Calcareous soils of the bottom lands occur in the flood plain of the Red River and consist chiefly of soil materials transported from the soils farther west, largely from red soils and formations of the "Red Beds." These soils are very productive, are readily cultivated, and for the most part have sufficiently good drainage to allow successful cultivation. In the virgin condition they had a forest growth of hackberry, elm, ash, pecan, and other trees, but few trees remain, as most of the land has been cleared for cultivation. The soils belong to the Miller, Roebuck, Pledger, and Yahola series.

## MILLER SERIES

The soils of the Miller series have red calcareous surface soils and heavy or moderately heavy calcareous red subsoils. These soils are smooth and have good drainage in most places. They are associated with the soils of the Yahola and Roebuck series. They differ from the Yahola soils in having heavier subsoils and from the Roebuck soils in having better natural drainage.

**Miller clay.**—The 8-inch surface soil of Miller clay is dark reddish-brown heavy calcareous clay, which is slightly crumbly when dry. This material grades into red calcareous silty clay that in most places is several feet thick, but in some places calcareous heavy fine sandy clay occurs below a depth of 2 feet. The content of fine sand increases with depth, and the material grades into red calcareous heavy fine sandy loam at a depth ranging from 4 to 6 feet. The surface soil crusts after rains and bakes on drying, but with proper cultivation a good tilth is obtained.

The principal variations in mapped areas of this soil consist of differences in depth to the comparatively light textured or sandy material. In nearly all places, however, the depth to the lighter textured material is not less than 36 inches. Other inclusions are small scattered areas of Miller silty clay loam.

Miller clay occurs in widely scattered areas in the wide bottom lands along the Red River. These areas are rather low and depressed, and overflows from the river cover the land once or twice in most years. Unusually heavy deposits of sediments are made during overflows, and growing crops are damaged. Although the surface is nearly level and drainage is slow, overflow in most years is sufficiently early in the season to allow crops to mature. In many of the lowest places, however, water accumulates in rainy periods and forms lakes, which may exist for several months. Many of these areas are so situated that artificial drainage can be established, and in some places this has been done by ditching.

This soil is not extensive. Possibly because of inadequate drainage, not more than 60 percent of it is cultivated. Corn and cotton are the principal crops, but in years of heavy rains and late overflows from the river late plantings of grain sorghums are made. Crops withstand dry weather well and usually produce better in dry than in wet seasons. It is not uncommon for yields of corn in the most favorable seasons to be as high as 50 bushels an acre. Because of damage by water, however, the average yield of corn is about 30 bushels an acre. Cotton produces about one-third to one-half bale.

**Miller silty clay loam.**—The 8- to 12-inch surface soil of Miller silty clay loam is dark-red calcareous silty clay loam. It grades into red calcareous silty clay loam or silty clay, which gradually becomes heavier with depth. In places the material below a depth of 36 inches is red calcareous fine sandy loam or very fine sandy loam. After rains the surface soil crusts and bakes to some extent and early crop growth is retarded, but when cultivated at the proper time the surface soil is generally of good tilth.

The surface is nearly level, and in some places it is slightly depressed. Drainage on some of the low areas is slow, but as a rule this is not a serious matter except in seasons of high rainfall accompanied by fre-

quent overflows from the river. Although overflows on this soil occur as frequently as on areas of Miller clay, damage to crops is not so severe because of more rapid drainage.

This soil is not extensive. It occupies small areas in the bottom lands along the Red River and is closely associated with Miller clay and the Yahola soils. About 80 percent of the soil is cultivated. Nearly all of the cropland is planted to corn and cotton, but during seasons of unfavorable moisture conditions, especially when corn and cotton have been damaged or destroyed in the early part of the season, the land is planted in grain sorghums. As on nearly all soils of the bottom land along the Red River, yields depend largely on moisture conditions during the early planting and growing seasons. Overflows and heavy rains during the late spring and early summer are more injurious to crops than the most severe late summer droughts. During the most favorable seasons corn yields about 45 bushels and cotton from  $\frac{1}{2}$  to 1 bale an acre, but the average yields of these crops throughout a long period are much lower.

**Miller very fine sandy loam.**—The surface soil of Miller very fine sandy loam is brownish-red friable calcareous very fine sandy loam, about 10 inches thick, grading through an 8-inch layer of heavy calcareous very fine sandy loam, clay loam, or very fine sandy clay into red heavy calcareous clay. This heavy clay material is several feet thick, but in many places the lower part of the subsoil contains some sand and becomes increasingly sandy with depth, changing to very fine sandy loam or fine sandy loam below a depth of 3 feet.

The surface is nearly level or very slightly undulating and as a rule is slightly higher than the adjoining soils. Drainage is good, and less damage by overflow is done to crops than on the other Miller soils. Because of the friable light-textured surface soil, a good tilth is easily maintained by cultivation. In long periods of dry weather, however, the loose surface soil in some areas blows severely in winds, but the wind does little damage to crops with the exception of early-planted ones.

This soil occupies a few fair-sized areas in the bottom land along the Red River, especially south and southeast and near the mouth of the Kiamichi River. It covers an area of only 384 acres, and nearly all of it is cultivated. Corn, cotton, grain sorghums, sorgo, and potatoes are the principal crops. Vegetables are also grown, and they produce well. About 60 percent of the land is planted to corn. Acre yields are about 30 bushels of corn, one-half bale of cotton, and 40 bushels of grain sorghums.

#### ROEBUCK SERIES

Members of the Roebuck series are characterized by red calcareous surface soils with subsoils ranging from red sandy material to mottled clay. These soils resemble the Miller soils but occupy either very poorly drained depressions that may be covered with water part of the year or old abandoned stream channels. As a rule these soils are not cultivated.

**Roebuck clay.**—The surface soil of Roebuck clay is dark reddish-brown calcareous heavy silty clay, about 8 inches thick. It is underlain by red calcareous heavy silty clay, which extends to a depth of several feet. Below a depth of 36 inches the material is slightly mot-

tled with gray, and below a depth of 42 inches it is light-red calcareous fine sandy clay. Included with this soil on the map are small areas of Roebuck silty clay loam.

At present none of this soil is farmed. It occupies old stream channels, depressions, or pockets in the lower bottom lands along the Red River. The total area is small. Natural drainage is poor, and the soil is frequently covered with water by local rains and overflow from the river. Water stands on the surface most of the winter and spring. Most of this soil supports a thick growth of small trees, principally willow, ash, maple, sycamore, Osage-orange, and cottonwood.

#### PLEDGER SERIES

The Pledger series includes soils of dark and red alluvium which are more or less calcareous and lie in high positions on the flood plains of streams draining both the "Red Beds" and dark soils of the plains and prairies. The surface soils are dark brown to black and about neutral to calcareous, and the subsoils are red and calcareous. In this county these soils occur near or at the confluence of the large stream valley of the Red River with tributary valleys occupied by streams that drain areas of dark prairie soils. These soils are comparatively well drained, highly productive, and largely utilized for the production of farm crops.

**Pledger clay.**—The surface soil of Pledger clay is very dark-brown or black clay, ranging from 6 to 12 inches in thickness, grading into an 8- to 10-inch layer of dark-brown heavy clay, which in turn grades into red or dark-red neutral or calcareous heavy clay. Below a depth of 26 inches small concretions of calcium carbonate occur. This material is several feet thick. The surface soil is sticky and plastic when wet. It crumbles readily on drying, however, and if cultivated under favorable moisture conditions a good tilth is obtained. Both surface soil and subsoil contain lime in many places.

There are a few variations in the mapped areas of this soil. The principal ones are in the thickness of the dark-colored surface soil and the color of the lower part of the subsoil. In some areas the very dark-brown or black surface soil layer is about 4 inches thick, and in others it ranges from 12 to 18 inches in thickness. In places the subsoil is mottled with gray below a depth of 30 inches.

This is not an extensive soil. It occurs in bottom lands along streams tributary to the Red River and is flooded at times by backwater from the river. Deposition of the sediments composing Pledger clay seems to have taken place in two stages. One stage represents the earlier deposition of red sedimentary material by backset floodwaters of the Red River; and the other and later stage represents the deposition of dark-colored sediments of the present surface soil, which were washed from soils of the prairie lands by streams tributary to the Red River. Although a few small widely scattered areas border the lower part of streams rising within the county, most areas border Muddy Boggy Creek and the Kiamichi River.

The surface is flat, and drainage is slow in many places. In the larger areas, particularly those along Muddy Boggy Creek and the Kiamichi River, the surface inclines gently toward the stream channels. In the lower parts of the areas, back from the channel, both surface and internal drainage are very slow and water remains on the surface for some time after overflows unless artificially drained.

Pledger clay is high in plant nutrients, and high yields of cotton, corn, and alfalfa are obtained in most years. Because of poor natural drainage in some of the areas, probably not more than one-half of the soil is devoted to crops. The more poorly drained part supports a thick cover of post oak, Osage-orange, hawthorn, elm, hackberry, ash, willow oak, and water oak trees. In favorable seasons corn yields about 40 bushels an acre, cotton about three-fifths bale, and alfalfa about 3 tons. About 60 percent of the soil in cultivation is planted to corn, 30 percent to cotton, and 10 percent to alfalfa and other crops.

#### YAHOLA SERIES

The Yahola series includes red or reddish-brown calcareous soils of the alluvial flood plains of streams that drain the western plains. The soil materials are largely materials transported by water from eroded formations of the "Red Beds" and red soils of the plains. These soils are characterized by red very sandy subsoils, which are lighter and coarser in texture than the surface soils. These soils are associated with the Miller soils and resemble them on the surface, but differ in the more sandy character of the subsoils and the lower inherent fertility.

**Yahola loamy very fine sand.**—The surface soil of Yahola loamy very fine sand is loose light-red loamy calcareous very fine sand, ranging from 6 to 12 inches in thickness. It grades into light-red or reddish-brown less heavy calcareous slightly loamy very fine sand or fine sand. Below a depth of 36 inches the material is rather loose and ranges from fine sand to very fine sand, with, in places, layers of indeterminate thickness of heavy and light more or less sandy calcareous material.

Included on the map with this soil are several very small areas of Yahola very fine sandy loam and Yahola fine sandy loam, the latter soil being located more particularly in areas close to the channel of the Red River.

The soil occupies areas on the Red River bottom lands in close association with areas of other Yahola soils, most of them bordering or lying near the channel of the river. These areas are fairly large, some of them covering as much as 450 acres. The surface is nearly level to gently undulating. In most places the soil lies several feet above the surrounding soils, but in some places it is lower. Natural drainage is generally good, and the porous condition of the subsoil allows rapid downward drainage. In general, overflows from the Red River are swift-running, and as a result the texture of the surface soil and the configuration of the land change rather frequently.

About 70 percent of the land is cultivated; the rest supports a good cover of Bermuda grass and is used for pasture. About 60 percent of the cultivated land is planted to corn, 25 percent to cotton, and the rest to sorgo, grain sorghums, and a few other crops. In the most favorable seasons—that is, those in which no overflows occur late in spring and the rainfall is rather high—crop yields are good, but during seasons of low rainfall and prolonged droughts the yields are low. The very sandy subsoil does not hold a large reserve of soil moisture, and crops suffer quickly in dry seasons. The average acre yield of corn is about 20 bushels and of cotton about one-third bale. Potatoes, sweetpotatoes, watermelons, and vegetables produce well in most seasons. Uncleared areas of this soil support a scant stand of cottonwood ash, post oak, willow oak, and sycamore.

**Yahola loamy fine sand.**—The 4- to 10-inch surface layer of Yahola loamy fine sand is reddish-brown loamy calcareous fine sand, which grades into light-brown or reddish-brown loamy calcareous fine sand. Below a depth of about 20 inches this material in turn grades into light-red or reddish-yellow loose calcareous fine sand. Small areas of Yahola loamy very fine sand are included with this soil on the map.

The surface is undulating to slightly hummocky. In the lower places the soil is generally heavier textured than in the higher places. Surface drainage is good, and the porous subsoil allows free under-drainage. This soil occurs in the bottom lands along the Red River, and most areas are adjacent to or near the river channel but lie several feet above the river bed and areas of riverwash.

Because of the porous surface soil and subsoil material, not a large store of soil moisture is held, and crops suffer quickly in dry seasons. Swift-running water during overflows changes the texture of the soil and the configuration of the land by shifting and depositing sandy materials. The soil is, therefore, not very desirable for cultivated crops, and not much of it is farmed; probably less than 5 percent of it is cultivated. It is low in plant nutrients, droughty, and subject to shifting by heavy winds. Its principal use is for the production of potatoes, sweet potatoes, watermelons, cantaloups, and a few vegetables. Fairly good yields of these crops are obtained in favorable seasons when rainfall provides adequate moisture. The scant grass cover affords very little pasture. The trees are principally cottonwood, ash, willow, and elm. The soil is probably fairly well suited to Bermuda grass, which produces good pasturage once a good stand is obtained.

**Yahola very fine sandy loam.**—The surface soil of Yahola very fine sandy loam is brown or dark brownish-red calcareous loose very fine sandy loam, ranging from 8 to 15 inches in thickness. It grades into dark-red calcareous very fine sandy loam. The color of this material becomes increasingly lighter with depth, and below a depth of 20 inches the material is light-red calcareous very fine sandy loam. Below a depth of 28 inches the material becomes more sandy and is red or light-red calcareous loamy very fine sand. In places a thin layer of red calcareous silty clay loam or silt loam occurs in the subsoil.

In nearly all places the subsoil is more sandy than the surface soil. This characteristic is rather uniform, but the depth to the lighter textured material is variable. Small areas of Yahola silty clay loam and Yahola clay are included with this soil on the map. In these places the surface is slightly undulating and the patches of heavier textured soils are in the lower situations.

The surface is level to gently undulating, and drainage is generally good. In small included spots of heavier textured soils in depressions, drainage is slow and in some seasons is insufficient for good growth of crops.

This soil occupies fairly large areas in the bottom lands along the Red River, some areas being more than 400 acres in size. They are rather irregular in shape and are closely associated with areas of Miller soils and other Yahola soils. This is one of the most extensive soils in the Red River bottom lands, and owing to its good drainage and high productivity it is more largely cultivated than the other soils of this bottom land.

Probably 95 percent is cultivated. About 60 percent of the cultivated land is planted to corn, and most of the rest is in cotton, with some grain sorghums, potatoes, and vegetables. In ordinary seasons corn yields about 30 bushels, cotton from one-third to two-thirds bale, and potatoes about 200 bushels an acre. Because of good drainage, a plentiful supply of plant nutrients, and a loose, friable condition, this soil is well suited to a wide variety of crops. In some seasons, especially those of prolonged drought, yields are somewhat lower because of low rainfall. A layer of silty clay or silty clay loam in the subsoil, even though it is thin, retains moisture much better than does the typical subsoil, which is very fine sand.

Where Yahola very fine sandy loam is uncultivated, the soil is partly wooded with an open growth of pecan, ash, hackberry, post oak, cottonwood, and a few other trees. Bermuda grass is the principal grass cover, although coarse weeds and needlegrass are abundant in idle fields.

**Yahola silty clay loam.**—The surface soil of Yahola silty clay loam is dark-red or brownish-red calcareous silty clay loam, about 9 inches thick. It grades into a 10-inch layer of dark-red heavy calcareous very fine sandy loam, which in turn grades into light-red calcareous loamy very fine sand. Below a depth of 40 inches the material is in places slightly heavier in texture. Although the heavy-textured surface soil is relatively sticky when wet and forms a crust in the upper 2 inches on drying, it crumbles readily when cultivated and a good tilth is formed. The subsoil as a rule is dominantly sandy, but thin layers of silty clay loam and silt loam of variable thickness occur throughout the sandy material.

This soil occurs in areas widely scattered throughout the Red River bottom lands. The surface is nearly level, and natural drainage on the surface is slow. The subsoil is porous, and water drains downward rather rapidly. After the water drains from the surface, the soil soon becomes sufficiently dry for cultivation and plant growth, but rain water stands on the surface longer than on the lighter textured Yahola soils.

About 80 percent of this soil is cultivated, and the rest is covered with trees, mainly hackberry, cottonwood, ash, sycamore, and elm. This is not an extensive soil, but owing to its agricultural value it is important. About 60 percent of the cultivated land is planted to corn and most of the rest to cotton. Some grain sorghums are grown, particularly on replanted land where overflows from the river have damaged or destroyed earlier planted crops. Because of the heavy-textured surface soil, which is retentive of moisture, and the fairly good drainage, yields of corn and cotton are slightly larger than those on the lighter textured Yahola soils. In normal seasons corn yields about 35 bushels and cotton about one-half bale an acre.

**Yahola clay.**—Yahola clay consists of dark reddish-brown calcareous clay, about 14 inches thick, underlain by light-red calcareous very fine sandy loam. This material becomes increasingly sandy with depth and gradually passes into calcareous loamy fine sand. The thickness of the upper clay layer varies somewhat, and in many places a thin layer of red clay or very fine sandy clay is in the subsoil.

This soil is not extensive and occurs in the Red River bottom lands. Many areas lie in somewhat low, depressed situations, associated in

places with old river channels. Natural drainage is poor, but in most years the soil is dry enough in the summer for the growth of late-planted crops. In places these areas hold water for some time after heavy rains and occasionally become lakes during wet seasons.

Only about 60 percent of Yahola clay is cultivated, and the rest is covered with a thick growth of trees, mainly hackberry, ash, elm, cottonwood, and willow. The abundance of plant nutrients and moisture makes this a productive soil. It is utilized almost entirely for the production of corn and cotton. Owing to frequent damage to crops by water, the average yields are comparatively low. In favorable years, however, corn returns from 35 to 40 bushels and cotton from one-half to three-fourths bale an acre. Under favorable drainage conditions this soil supports a good cover of Bermuda grass.

#### MISCELLANEOUS SOILS AND LAND TYPES UNSUITED TO CULTIVATION

The group of miscellaneous soils and land types unsuited to cultivation is made up of widely differing soils and land types that have for the most part only one general feature in common—that is, they are all entirely physical nonarable or otherwise unsuited for use for cultivated farm crops. The land is either too rough or too stony for cultivation or is so sandy, eroded, or steep that cultivation is not profitable. It is more or less suited, however, to pasture or forest, of either native or introduced vegetation. The usefulness of the several members of this group varies with their general characteristics.

**Denton stony clay.**—Denton stony clay is partly barren and is largely composed of fragmentary fossiliferous (Caddo) limestone. The individual areas of soil and rock form an intricate pattern, with small spots or patches several feet in diameter, which have a layer, ranging from 2 to 10 inches in thickness, of brown or dark-brown clay intermingled with large and small fragments of limestone. This layer is underlain by bedrock. Denton clay, shallow phase, in areas too small to indicate separately, is included with this soil on the map. In places Denton stony clay is brown calcareous clay containing much fragmentary limestone, which, at a depth ranging from 6 to 12 inches, merges with yellow stony marl resting on a bed of disintegrated limestone.

This soil is rather extensive. About 46 percent of it is in large areas in the southeastern part of the county, and the rest is in widely scattered areas in the northwestern and central parts. This land is used only for grazing. The surface is nearly level or undulating and in places is moderately sloping. Except for inclusions of small well-grassed areas of Denton clay, shallow phase, the land supports a rather thin grass cover and affords only moderate grazing. Probably from 8 to 12 acres are necessary to pasture a cow for 9 months of the year.

The grass cover consists chiefly of prairie beardgrass (little bluestem) and bluejoint turkeyfoot (big bluestem), with some grama and other grasses, most of which are rather nutritious. A scattered growth of Osage-orange, winged elm, sumac, and a few other trees and shrubs occurs in places.

**Rough stony land (Denton soil material).**—Rough stony land (Denton soil material) consists of steep slopes and ridges with limestone outcrops and large and small rock fragments scattered over the surface. A small amount of brown fine earth or clay occurs between

the rock fragments and in a thin layer over some of the bedrock. The areas consist of exceedingly stony steep slopes cut in places by gullies, which are a result of either normal erosion or accelerated erosion caused by grazing. The slopes are moderate to steep and in places are precipitous. Geologically, the limestone rock belongs to the Caddo and Goodland members of the Lower Cretaceous.

This land is rather extensive. The largest areas are in the southeastern and northwestern parts of the county and in the central part closely associated with dark-colored prairie lands. Most of the bodies occur in long, narrow strips forming the slopes of small stream valleys.

Included with the mapped areas, especially the larger ones, are small nearly level patches of Denton stony clay, Denton clay, shallow phase, and Crawford stony loam. These associated soils afford somewhat better grazing than the rough stony land.

This land supports a thin to moderate cover of bluestem, grama, and other grasses, which have fairly good nutritive qualities, and it is largely, perhaps entirely, used for grazing. In places there are scattered growths of oak, elm, Osage-orange, cedar, and a few other trees.

**Crawford stony loam.**—Crawford stony loam consists of a 4- to 10-inch layer of reddish-brown or brownish-red loam intermingled with large and small fragments of limestone and resting on bedrock of limestone. Where it is exposed on the surface the limestone breaks on weathering into sharp angular fragments. Included on the map with areas of this soil are small areas of limestone outcrops with very little decomposed fine earth material on the surface except in cracks and along small crevices. Other inclusions are chiefly small associated bodies of Newtonia very fine sandy loam.

The surface is undulating to gently rolling. None of the land is cultivated. It supports a thin cover of grasses, principally prairie beardgrass, blue grama, and side-oats grama. A thin growth of trees and brush, consisting of Osage-orange, winged elm, oak, hawthorn, persimmon, sumac, and buckbrush, has encroached on the soil.

This soil occurs in a number of small areas lying chiefly north and northwest of Hugo and in the northwestern part of the county, closely associated with areas of Newtonia soils. The soil is used for grazing, and the native grasses, although not thick, are nutritious and afford valuable range forage.

**Cuthbert fine sandy loam, steep phase.**—The steep phase of Cuthbert fine sandy loam generally occupies similar positions to those of the typical soil, but it is largely unsuited to cultivation, owing to the steepness of the slopes. In several areas the underlying clay or stony material outcrops. The soil consists of a 4-inch surface soil of light grayish-brown fine sandy loam grading into pale-yellow fine sandy loam, which in turn grades into reddish-yellow fine sandy clay at a depth ranging from 8 to 15 inches. The thickness of this upper subsoil layer ranges from 4 to 8 inches, depending on the degree of slope, and it is very thin on the steeper slopes. Below a depth of 12 to 18 inches this material grades into mottled gray and yellow fine sandy clay that is rather friable when dry but has a slick feel when wet. On the steeper slopes where erosion has been most active the geological beds of mottled sandy clay or sandstone outcrop and the surface in places is strewn with fragments of sandstone. Both the surface soil and the subsoil are acid in reaction.

Small areas of the typical soil and also included bodies of Norfolk and Ruston soils are shown on the map. Most areas of the typical soil are along the lower slopes, and the bodies of Norfolk and Ruston soils are on the narrow ridges and divides.

The surface is gently to strongly rolling, and erosion has been active on steep slopes, even though they are forested. This soil occupies rather large areas in the northeastern part of the county, where it has been developed from Trinity sands of the Lower Cretaceous. The areas range in size from about 40 acres to more than 7 square miles. The soil supports a small amount of coarse bunchgrasses, some of which are species of *Andropogon*. In places where the stand of trees is thin the land supports a fairly good cover of these grasses and is of some value for grazing. It is estimated by local stockmen that from 12 to 15 acres are required to support a cow throughout the year. Trees, especially pine, grow fairly rapidly on this land. The tree growth consists principally of pine, blackjack oak, red oak, post oak, gum, and hickory.

A few small areas are cultivated, but these are chiefly on smoother areas of the typical soil included within large areas of the generally rolling and hilly steep phase. The crops are about the same as those grown on the typical soil elsewhere, and yields are about the same. Where some farming has been done on the steeper slopes accelerated erosion has caused the land to become severely washed and gullied, and the fields have been abandoned to grow up in old-field pine and brush. Many small deep ravines and narrow valleys extend into all parts of areas of this soil.

It would seem that this soil is probably better suited for trees than for any other crop, and doubtless reforestation with pine would be feasible.

**Pottsville stony fine sandy loam.**—The surface soil of Pottsville stony fine sandy loam is dark grayish-brown fine sandy loam intermingled with many angular and subangular very hard fragments of sandstone, grading at a depth of about 2 inches into a 4-inch layer of reddish-brown heavy clay containing a large amount of sandstone. This layer is underlain by consolidated sandstone of the Jack Fork (Carboniferous) formation. The soil material is slightly acid in reaction. The depth to the bedrock varies in different places, but in most places rock is within a depth of 10 inches. In some places the surface is strewn with square and rectangular sandstone blocks.

On one long moderately steep slope the surface soil is thin grayish-brown fine sandy loam containing many stony fragments. This material is underlain by yellow stony fine sandy loam, which at a depth of 10 inches rests on red heavy clay that is not stony. At a depth of 24 inches this grades into red and gray mottled waxy tough dense clay.

Pottsville stony fine sandy loam occurs in a few small areas in the northeastern part of the county, closely associated with the large areas of rough stony land (Pottsville soil material). Most of this soil is in the more nearly level areas and on lower slopes along the border and fringe of the ridges of rough land. The surface is in most places gently undulating.

A small amount of native grass affords scant forage, which is used for pasturing cattle. The forest growth consists mostly of blackjack oak, hickory, and pine. The land is too stony for use for cultivated crops.

**Rough stony land (Pottsville soil material).**—Rough stony land (Pottsville soil material) occupies high ridges and hills with steep slopes. It consists chiefly of massive and some small rock fragments and ledges of consolidated sandstone of the Jack Fork formation. Owing to the very stony rough character of the areas, very little fine earth is on the surface. In places a small amount of red or reddish-brown fine sandy loam a few inches thick over red fine sandy clay occurs between the massive rock fragments, and this is sufficient to support the rather abundant tree growth.

The land comprises ridges that rise high above the general surface of the surrounding rolling lands, giving a mountainous appearance. These areas are southern outliers of the rough mountainous lands of the Ouachita province, of which the main area is several miles to the north of this county. The exposed rock covers almost the entire surface of this land, but some decomposed weathered fine-grained material is along the cracks and crevices. Pottsville stony fine sandy loam occurs in small areas in the smoother places but is not shown separately on the map.

The land has practically no value for pasture. A growth of pine, blackjack oak, post oak, and hickory trees covers most of the land. The trees grow slowly and are of little value except for firewood. Probably much of the merchantable pine timber has been cut.

**Susquehanna clay.**—Susquehanna clay consists of steep eroded slopes where practically all of the surface soil has been washed away. The surface soil is gray very fine sandy loam, from 1 to 3 inches in thickness, or it may be entirely absent. Below is mottled red and gray dense waxy clay that has an increasingly large proportion of gray with depth. This is the slightly weathered parent material. Included small areas occur with deeply eroded bare yellow or red clay, and other areas have a thin layer of sandy material on the surface.

The surface is steeply sloping and cut by numerous gullies, and the land is almost rough enough to be classed as rough broken land. It is of slight extent and occurs in several small widely separated areas in the north-central and northwestern parts of the county in blufflike escarpments.

This soil supports a forest growth of pine, post oak, blackjack oak, hickory, and other trees. The tree growth is not so thick and other vegetation is not so abundant as to prevent additional severe erosion during every rainfall.

**Cahaba fine sand, steep phase.**—Cahaba fine sand, steep phase, is a loose, deep sandy soil occupying steep slopes along the eroded escarpment of the very high ancient terrace of old Red River alluvium in the southern part of the county. The surface layer consists of light grayish-brown loose fine sand, 3 or 4 inches thick, which is incoherent and contains a very small amount of organic matter in the form of leafmold. It is acid in reaction. In cultivated fields the surface layer is about 6 to 8 inches thick. It grades into a subsurface layer of loose reddish-yellow acid fine sand. In many places this sand continues to a depth of many feet, but in some places spots occur where yellow or red fine sandy loam or fine sandy clay lies within 2 feet of the surface. Near the tops of the steep slopes occupied by this soil the sand is not more than 15 inches thick over red or yellow clay. This represents

the merging of the areas of this soil with the higher lying less steep areas of the Kalmia and Cahaba soils. In places the subsoil is yellow and similar to that of Kalmia fine sand.

The land is very steep in most places, the gradient ranging from about 5 to 20 percent, or even more in places. This soil is of slight extent and occurs in narrow areas a few miles southwest and west of Grant in the southern part of the county. It represents an outcropping of old river sand, which lies beneath a high ancient stream terrace in the Red River Valley. It is from 5 to 20 feet below the general surface of the undulating old terrace and outcrops at the outer edge of the terrace at the point of contact with the present flood plain of the Red River. It also occupies numerous deep very short valleys and gullies, which reach back from the Red River flood plain and find their source within the higher lying terrace areas.

Drainage is rapid, but the soil is so loose that much water sinks into the soil before run-off takes place. As both surface drainage and underdrainage are rapid, the soil is leached. Practically all of the soil remains in the original forest growth of post oak, blackjack oak, hickory, and other trees. Only very small areas are cleared or planted to crops, and even such cultivation is incidental because of the location of this soil in cultivated fields made up chiefly of other soils. This soil alone is probably not of sufficient agricultural value to use for crops. Doubtless if erosion and leaching were not excessive, such crops as watermelons, sweetpotatoes, peas, berries, fruits, and grapes might be grown to some advantage, although it would be necessary to use fertilizers and manures in order to establish even moderate productivity.

**Riverwash.**—Riverwash consists of bare sandy material, which, with the exception of a small area along the Kiamichi River, occurs along the channel of the Red River. The material is loose calcareous light-yellow or reddish-yellow fine sand with pockets of silt and clay here and there. During flood stages of the streams, areas of riverwash are covered to a depth of several feet by swiftly moving water, which removes the sand from one place and deposits it in another. The constant shifting of the material by water, and to some extent by wind when the material is dry, has prevented the growth of vegetation. Riverwash has no agricultural value either for cultivated crops or for grazing. It is inextensive.

## PRODUCTIVITY RATINGS AND LAND CLASSIFICATION

In table 5 the soils of Choctaw County are listed according to soil series and estimated average acre yields of the principal crops are given for each soil. These averages represent production under prevailing soil-management practices for the years when climatic conditions are fairly favorable.

The yield estimates are based on reports of farmers, and they are presented only as estimates of production for the average of the more favorable years. In other words, they are not presented as averages of all the years including the very good and the very bad. The yields on a given soil type vary greatly with differences in rainfall and other climatic conditions from year to year and with differences in management. Actually, the details of soil management differ from farm to farm, and so it is realized that the estimates in table 5 may not apply

directly to specific areas of land for any particular year. In addition, it is realized that soils as they are delineated on a soil map vary somewhat in their productivity. These estimates, however, seem to be as accurate information as can be obtained without further detailed and lengthy investigation, and they serve to bring out the relative productivity of the soils shown on the map.

No numerical estimates of yields are given for vegetables, because of the limited information as to yields of the individual kinds of vegetables from the small fields on which they are grown. Descriptive terms are used to bring out the local differences in productivity. The same statement applies to the descriptive terms used for pasture.

The agriculture of Choctaw County, as stated elsewhere in this report, consists chiefly of the production of cotton and corn, although other crops are grown and some cattle, hogs, and poultry are raised. The soil-management practices include occasional fertilization for cotton, but methods are not distinctly intensive, and little effort is made to use crop rotations, green manures, and liberal quantities of fertilizer, and to control erosion. In other words, it seems reasonable to assume that the present productivity could be increased considerably by proper management practices.

In order to compare directly the yields obtained in Choctaw County with those obtained in other parts of the country, yield figures have been converted in table 6 to indexes based on standard yields. The soils are listed in the approximate order of their general productivity for cotton and corn under prevailing farming practices, the most productive at the head of the table.

TABLE 5.—Estimated average acre yields of the more important crops on the soils of Choctaw County, Okla.<sup>1</sup>

| Soil (soil types, phases, complexes, and land types) | Cotton        | Corn           | Oats           | Grain sorghums | Peanuts        | Alfalfa     | Sorghum forage | Potatoes       | Vegetables | Prairie hay | Pasture            |
|--|---------------|----------------|----------------|----------------|----------------|-------------|----------------|----------------|------------|-------------|--------------------|
|  | <i>Pounds</i> | <i>Bushels</i> | <i>Bushels</i> | <i>Bushels</i> | <i>Bushels</i> | <i>Tons</i> | <i>Tons</i>    | <i>Bushels</i> |            | <i>Tons</i> |                    |
| Atkins silt loam <sup>2</sup>                        | 100           | 10             | 18             | 18             | 12             |             | 1              | 50             | Poor       |             | Poor to fair.      |
| Atkins silt loam, high-bottom phase                  | 120           | 12             | 25             | 22             |                | 1.25        | 110            | do             |            |             | Do.                |
| Atkins silty clay loam <sup>2</sup>                  | 80            | 10             | 16             | 18             |                | 1           |                | do             |            |             | Do.                |
| Bibb very fine sandy loam <sup>2</sup>               | 110           | 10             | 20             | 20             | 12             |             | 1.25           | 60             | do         |             | Do.                |
| Boswell very fine sandy loam                         | 130           | 12             | 15             | 15             | 12             |             | 1.25           | Fair           |            |             | Fair to good.      |
| Bowie fine sandy loam                                | 100           | 12             | 17             | 20             | 25             |             |                | 125            | Good       |             | Fair.              |
| Bowie very fine sandy loam                           | 125           | 14             | 20             | 20             | 18             |             | 1.50           | 150            | do         |             | Fair to good.      |
| Brewer silty clay loam <sup>2</sup>                  | 300           | 35             | 16             | 40             | 16             | 4           | 1              | 140            | Poor       |             | Fair.              |
| Cahaba fine sand, steep phase                        |               |                |                |                |                |             |                |                |            |             | Poor to fair.      |
| Cahaba very fine sandy loam                          | 130           | 15             | 20             | 20             | 15             | 4.50        | 1.25           | 120            | Good       |             | Fair to good.      |
| Choctaw very fine sandy loam                         | 160           | 18             | 30             | 25             | 25             | .50         | 1.50           |                | do         | 1.50        | Do.                |
| Crawford stony loam                                  |               |                |                |                |                |             |                |                |            |             | Fair to poor.      |
| Crockett clay loam                                   | 100           | 10             | 20             | 20             | 18             | .50         | 1.25           | 80             | Poor       | 1           | Good to fair.      |
| Cuthbert fine sandy loam                             | 80            | 10             | 16             | 12             | 12             |             | 1.50           | 60             | Fair       |             | Poor to fair.      |
| Cuthbert fine sandy loam, steep phase                |               |                |                |                |                |             |                |                |            |             | Poor.              |
| Denton clay, shallow phase                           | 140           | 20             | 30             | 25             | 16             | .50         | 1.50           | 80             | Poor       | 1           | Good.              |
| Denton clay  | 230           | 30             | 40             | 40             | 20             | 1.50        | 1.75           |                | Fair       | 1.50        | Excellent.         |
| Denton stony clay                                    |               |                |                |                |                |             |                |                |            |             | Fair to poor.      |
| Durant silt loam                                     | 160           | 18             | 30             | 28             | 20             | .50         | 1.50           | 120            | Fair       | 1.50        | Good.              |
| Durant silty clay loam                               | 230           | 30             | 33             | 30             | 18             | 1           | 1.75           | 140            | do         | 1.50        | Excellent.         |
| Durant-San Saba complex                              | 130           | 18             | 30             | 25             | 18             | .75         | 1.50           | 100            | do         | 1.25        | Good.              |
| Kalmia fine sand                                     | 100           | 8              | 15             | 15             | 15             |             | 1.25           | 70             | do         |             | Poor.              |
| Kalmia fine sandy loam                               | 120           | 15             | 18             | 18             | 20             |             | 1.25           | 80             | Good       |             | Fair.              |
| Kalmia very fine sandy loam                          | 130           | 15             | 20             | 18             | 15             |             | 1.50           | 100            | do         |             | Fair to good.      |
| Kaufman clay <sup>2 3</sup>                          | 300           | 40             | 32             | 35             | 14             | 2.25        | 1.25           | 80             | Fair       |             | Fair.              |
| Kirvin fine sandy loam                               | 150           | 14             | 22             | 20             | 20             |             | 1.75           | 120            | Good       |             | Fair to good.      |
| Kirvin fine sandy loam, rolling phase                | 60            | 8              | 18             | 16             | 14             |             | .75            | 60             | Fair       |             | Fair.              |
| Lonoke very fine sandy loam                          | 230           | 34             | 28             | 40             | 20             | 3           | 1.75           | 225            | Good       |             | Good to excellent. |
| Lonoke silty clay loam                               | 270           | 42             | 22             | 45             | 18             | 4.50        | 1.50           | 200            | Fair       |             | Do.                |
| Lonoke clay  | 260           | 38             | 20             | 40             | 16             | 3.50        | 1.50           | 150            | Poor       |             | Do.                |
| Lufkin very fine sandy loam <sup>3</sup>             | 130           | 10             | 12             | 15             | 12             |             | 1.50           | 50             | do         |             | Poor.              |
| Miller very fine sandy loam                          | 230           | 30             | 30             | 40             | 20             | .75         | 1.25           | 190            | Good       |             | Fair.              |
| Miller silty clay loam                               | 300           | 42             | 30             | 40             | 12             | 1.50        | 1.25           | 120            | Fair       |             | Do.                |
| Miller clay <sup>3</sup>                             | 240           | 30             | 30             | 35             |                | 1           | 1.25           | 100            | do         |             | Do.                |
| Myatt very fine sandy loam <sup>2</sup>              | 130           | 12             | 15             | 15             | 15             |             | 1.50           | 60             | do         |             | Fair to poor.      |
| Myatt silt loam <sup>2</sup>                         | 100           | 10             | 15             | 15             | 12             |             | 1.50           | 40             | Poor       |             | Do.                |
| Myatt silty clay loam <sup>2</sup>                   | 80            | 8              | 12             | 15             |                |             | 1.25           | 30             | do         |             | Poor.              |
| Newtonia very fine sandy loam                        | 120           | 12             | 25             | 20             | 15             |             | 1.50           | 90             | Fair       | 1           | Good to excellent. |
| Newtonia silt loam                                   | 140           | 18             | 25             | 20             | 15             |             | 1.50           | 125            | do         | 1.25        | Do.                |
| Norfolk loamy fine sand                              | 100           | 10             | 12             | 15             | 15             |             | 1.25           | 90             | do         |             | Fair to poor.      |
| Norfolk fine sandy loam                              | 130           | 15             | 20             | 22             | 18             |             | 1.50           | 125            | Good       |             | Fair to good       |

|   |     |    |    |    |    |      |      |     |      |      |                    |
|---|-----|----|----|----|----|------|------|-----|------|------|--------------------|
| Norfolk fine sandy loam, deep phase         | 120 | 12 | 15 | 22 | 20 |      | 1.25 | 100 | do   |      | Fair.              |
| Ochlockonee very fine sandy loam            | 250 | 30 | 35 | 40 | 18 | 1.50 | 1.75 | 180 | do   |      | Good.              |
| Ochlockonee clay loam <sup>2</sup>          | 120 | 18 | 20 | 30 | 14 | .50  | 1.25 | 80  | Fair |      | Fair.              |
| Osage clay                                  | 300 | 40 | 30 | 40 |    | 2    | 1.50 | 130 | do   | .50  | Excellent.         |
| Pledger clay                                | 280 | 40 | 30 | 45 |    | 3    | 1.50 | 120 | do   |      | Good.              |
| Pope loamy fine sand <sup>3</sup>           | 100 | 12 | 20 | 20 | 12 |      | 1    | 80  | do   |      | Poor to fair.      |
| Pope fine sandy loam <sup>3</sup>           | 150 | 20 | 22 | 25 | 14 |      | 1.25 | 180 | do   |      | Good.              |
| Pottsville stony fine sandy loam            |     |    |    |    |    |      |      |     |      |      | Poor.              |
| Pulaski loamy fine sand <sup>3</sup>        | 160 | 28 | 35 | 35 | 25 | 1    | 1.25 | 180 | Good | .25  | Good.              |
| Riverwash                                   |     |    |    |    |    |      |      |     |      |      | Very poor.         |
| Roebuck clay                                |     |    |    |    |    |      |      |     |      |      | Poor.              |
| Rough stony land (Denton soil material)     |     |    |    |    |    |      |      |     |      |      | Do.                |
| Rough stony land (Pottsville soil material) |     |    |    |    |    |      |      |     |      |      | Do.                |
| Ruston loamy fine sand                      | 100 | 12 | 16 | 20 | 17 |      | 1.75 | 100 | Fair |      | Fair.              |
| Ruston fine sandy loam                      | 130 | 14 | 22 | 22 | 20 |      | 1.50 | 110 | Good |      | Do.                |
| Ruston very fine sandy loam                 | 160 | 17 | 25 | 25 | 20 |      | 1.75 | 125 | do   |      | Fair to good.      |
| San Saba clay                               | 240 | 35 | 40 | 40 | 20 | 1.75 | 2    | 120 | Fair | 2    | Excellent.         |
| San Saba clay, shallow phase                | 160 | 20 | 25 | 30 | 15 | 1    | 1    | 110 | do   | 1.50 | Good.              |
| Sawyer very fine sandy loam                 | 140 | 15 | 18 | 20 | 15 |      | 1.50 | 60  | Good |      | Fair to poor.      |
| Susquehanna clay                            |     |    |    |    |    |      |      |     |      |      | Poor.              |
| Teller fine sandy loam                      | 140 | 17 | 20 | 20 | 17 | .50  | 1.50 | 160 | Good |      | Good.              |
| Teller very fine sandy loam                 | 160 | 25 | 25 | 25 | 20 | 1    | 1.75 | 180 | do   |      | Good to excellent. |
| Verdigris very fine sandy loam              | 240 | 30 | 35 | 40 | 20 | 1.50 | 1.50 | 180 | do   |      | Do.                |
| Verdigris silty clay loam                   | 200 | 35 | 30 | 40 | 14 | 2    | 1.50 | 120 | Fair | .25  | Do.                |
| Yahola loamy fine sand                      | 140 | 18 | 20 | 30 | 20 | .75  | 1    | 150 | Good |      | Fair.              |
| Yahola loamy very fine sand                 | 160 | 20 | 30 | 30 | 20 | 1    | 1.25 | 160 | do   |      | Fair to good.      |
| Yahola very fine sandy loam                 | 220 | 30 | 30 | 35 | 20 | 1    | 1.50 | 200 | do   |      | Do.                |
| Yahola silty clay loam                      | 240 | 35 | 30 | 40 | 18 | .75  | 1.50 | 140 | Fair |      | Fair.              |
| Yahola clay                                 | 220 | 35 | 30 | 35 | 15 | .50  | 1.50 | 110 | do   |      | Do.                |

<sup>1</sup> The figures in this table represent estimated average yields that may be expected under the prevailing soil-management practices in years when climatic conditions are favorable. The practices referred to include the use of very little commercial fertilizer but may include the use of manure produced on the land. Absence of indexes shows that the crop is not grown on the particular soil type.

<sup>2</sup> These soils are naturally poorly drained. The yields given are for areas in which some artificial drainage has been provided or in which natural drainage is better than average.

<sup>3</sup> These soils are subject to rather frequent overflood that damages crops. The yields given are for crops grown during the more favorable seasons.

TABLE 6.—*Productivity ratings of the soils of Choctaw County, Okla.*

| Soil <sup>1</sup> (soil types, phases, complexes, and land types) | Crop productivity index <sup>2</sup> for— |                 |                 |                           |                     |                   |                         |                       |                          |                                   | General productivity grade <sup>3</sup> (based on cotton and corn) | Soil group as shown on map legend | General classification <sup>4</sup>  |   |
|---|---|-----------------|-----------------|---------------------------|---------------------|-------------------|-------------------------|-----------------------|--------------------------|-----------------------------------|--|-----------------------------------|--|---|
|   | Cotton 100=400 lbs.                       | Corn 100=50 bu. | Oats 100=50 bu. | Grain sorghums 100=40 bu. | Pea-nuts 100=40 bu. | Al-falfa 100=4 T. | Sorghum forage 100=4 T. | Pota-toes 100=200 bu. | Vege-tables <sup>3</sup> | Prairie hay <sup>4</sup> 100=2 T. |  |                                   |  | Pasture <sup>3</sup>  |
| Miller silty clay loam.....                                       | 75  | 85              | 60              | 100                       | 30                  | 38                | 32                      | 60                    | Fair.....                |                                   | Fair.....  | 3.....                            | Soils of the bottom lands. Well drained, heavy, red, calcareous. Soils of the bottom lands. Well drained, heavy, dark colored. Soils of the bottom lands. Poorly drained, heavy, dark colored. Dark soils of the forested terraces. Heavy textured; slow drainage. Soils of the bottom lands. Well drained, heavy, red, calcareous subsoils. Dark soils of the forested terraces. Heavy textured, poorly drained. Dark soils of the forested terraces. Heavy textured, slow drainage. Dark soils of the upland prairies. Deep, heavy textured. Soils of the bottom lands. Well drained, heavy, red, calcareous subsoils. Dark soils of the forested terraces. Medium textured. Soils of the bottom lands. Well drained, heavy, red, calcareous subsoils. Soils of the bottom lands. Well drained, medium textured, light-colored. Soils of the bottom lands. Well drained, medium textured, dark colored. Soils of the bottom lands. Well drained, heavy, red, calcareous. Soils of the bottom lands. Well drained, heavy, dark colored. Dark soils of the upland prairies. Deep, heavy textured. Soils of the bottom lands. Well drained, medium textured, red, calcareous subsoils. Dark soils of the upland prairies. Deep, heavy textured. Soils of the bottom lands. Well drained, medium textured, red, calcareous subsoils. | Generally good cropland and fair to excellent pasture. Inherent fertility high for most of these soils. Productivity generally high, but varies with drainage and overflow conditions. Heavy textures make tillage relatively difficult on some of these soils. |
| Osage clay.....   | 75  | 80              | 60              | 100                       | -----               | 50                | 38                      | 65                    | do.....                  | 25                                | Excellent.....   |                                   |  |   |
| Kaufman clay ?.....   | 75  | 80              | 65              | 88                        | 35                  | 55                | 32                      | 40                    | do.....                  |                                   | Fair.....  |                                   |  |   |
| Lonoke silty clay loam....  | 68  | 85              | 45              | 112                       | 45                  | 112               | 38                      | 100                   | do.....                  |                                   | Good to excellent.   |                                   |  |   |
| Pledger clay.....   | 70  | 80              | 60              | 112                       | -----               | 75                | 38                      | 60                    | do.....                  |                                   | Good.....  |                                   |  |   |
| Brewer silty clay loam ?..  | 75  | 70              | 32              | 100                       | 40                  | 100               | 25                      | 70                    | Poor.....                |                                   | Fair.....  |                                   |  |   |
| Lonoke clay.....  | 65  | 75              | 40              | 100                       | 40                  | 88                | 38                      | 75                    | do.....                  |                                   | Good to excellent.   |                                   |  |   |
| San Saba clay.....  | 60  | 70              | 80              | 100                       | 50                  | 45                | 50                      | 60                    | Fair.....                | 100                               | Excellent.....   |                                   |  |   |
| Yahola silty clay loam....  | 60  | 70              | 60              | 100                       | 45                  | 20                | 38                      | 70                    | do.....                  |                                   | Fair.....  |                                   |  |   |
| Lonoke very fine sandy loam.                                      | 58  | 68              | 56              | 100                       | 50                  | 75                | 44                      | 112                   | Good.....                |                                   | Good to excellent.   |                                   |  |   |
| Yahola clay.....  | 55  | 70              | 60              | 88                        | 38                  | 12                | 38                      | 55                    | Fair.....                |                                   | Fair.....  |                                   |  |   |
| Ochlockonee very fine sandy loam.                                 | 62  | 60              | 70              | 100                       | 45                  | 38                | 45                      | 90                    | Good.....                |                                   | Good.....  |                                   |  |   |
| Verdigris very fine sandy loam.                                   | 60  | 60              | 70              | 100                       | 50                  | 38                | 38                      | 90                    | do.....                  |                                   | Good to excellent.   |                                   |  |   |
| Miller clay.....  | 60  | 60              | 60              | 88                        | -----               | 25                | 32                      | 50                    | Fair.....                |                                   | Fair.....  |                                   |  |   |
| Verdigris silty clay loam..                                       | 50  | 70              | 60              | 100                       | 35                  | 50                | 38                      | 60                    | do.....                  | 15                                | Good to excellent.   |                                   |  |   |
| Denton clay.....  | 58  | 60              | 80              | 100                       | 50                  | 38                | 45                      | -----                 | do.....                  | 75                                | Excellent.....   |                                   |  |   |
| Miller very fine sandy loam.                                      | 58  | 60              | 60              | 100                       | 50                  | 20                | 32                      | 95                    | Good.....                |                                   | Fair.....  |                                   |  |   |
| Durant silty clay loam....  | 58  | 60              | 65              | 75                        | 45                  | 25                | 45                      | 70                    | Fair.....                | 75                                | Excellent.....   |                                   |  |   |
| Yahola very fine sandy loam.                                      | 55  | 60              | 60              | 88                        | 50                  | 25                | 38                      | 100                   | Good.....                |                                   | Fair.....  |                                   |  |   |

|                               |    |    |    |    |    |     |    |    |      |    |                    |   |   |
|-------------------------------|----|----|----|----|----|-----|----|----|------|----|--------------------|---|---|
| Pulaski loamy fine sand...    | 40 | 55 | 70 | 88 | 63 | 25  | 32 | 90 | Good | 15 | Good               | 6   | Soils of the bottom lands. Well drained, light textured, dark colored.            |
| Teller very fine sandy loam.  | 40 | 50 | 50 | 63 | 50 | 25  | 45 | 90 | do   |    | Good to excellent. |   | Dark soils of the forested terraces. Medium textured.                             |
| Yahola loamy very fine sand.  | 40 | 40 | 60 | 75 | 50 | 25  | 30 | 80 | do   |    | Fair to good.      | Soils of the bottom lands. Well drained, light textured; red calcareous subsoils. |   |
| San Saba clay, shallow phase. | 40 | 40 | 50 | 75 | 38 | 25  | 25 | 55 | Fair | 75 | Good               | 7   | Shallow, heavy-textured soils. Prairie.   |
| Pope fine sandy loam s.       | 38 | 40 | 44 | 63 | 35 |     | 32 | 90 | do   |    | do                 |   | Soils of the bottom lands. Well drained, medium textured, light colored.          |
| Choctaw very fine sandy loam. | 40 | 35 | 60 | 63 | 63 | 12  | 38 |    | Good | 75 | Fair to good.      | Dark soils of the upland prairies. Deep, medium textured.                         |   |
| Durant silt loam              | 40 | 35 | 60 | 70 | 50 | 12  | 38 | 60 | Fair | 75 | Good               | do  | Light-colored soils of the forested uplands. Medium-textured subsoils.            |
| Ruston very fine sandy loam.  | 40 | 35 | 50 | 63 | 50 |     | 45 | 63 | Good |    | Fair to good.      |   | Shallow, heavy-textured soils. Prairie.   |
| Denton clay, shallow phase.   | 35 | 40 | 60 | 63 | 40 | 12  | 38 | 40 | Poor | 50 | Good               | do  | Soils of the bottom lands. Well drained, light textured; red calcareous subsoils. |
| Yahola loamy fine sand...     | 35 | 35 | 40 | 75 | 50 | 20  | 25 | 75 | Good |    | Fair               |   | Dark soils of the upland prairies. Deep, medium textured.                         |
| Newtonia silt loam            | 35 | 35 | 50 | 50 | 38 |     | 38 | 63 | Fair | 65 | Good to excellent. | do  | Dark soils of the forested terraces. Medium textured.                             |
| Teller fine sandy loam        | 35 | 35 | 40 | 50 | 43 | 12  | 38 | 80 | Good |    | Good               |   | Dark soils of the upland prairies. Deep, heavy textured.                          |
| Durant-San Saba complex.      | 32 | 35 | 60 | 63 | 45 | 20  | 38 | 50 | Fair | 65 | do                 | 7   | Light-colored soils of the forested uplands. Medium-textured subsoils.            |
| Kirvin fine sandy loam        | 38 | 28 | 45 | 50 | 50 |     | 45 | 60 | Good |    | Fair to good.      |   | Soils of the bottom lands. Poorly drained, heavy, light colored.                  |
| Ochlockonee clay loam         | 30 | 35 | 40 | 75 | 35 | 12  | 32 | 40 | Fair |    | Fair               | do  | Light-colored soils of the forested uplands. Heavy subsoils; slow drainage.       |
| Sawyer very fine sandy loam.  | 35 | 30 | 35 | 50 | 38 |     | 38 | 30 | Good |    | Fair to poor.      |   | Light-colored soils of the forested uplands. Medium-textured subsoils.            |
| Norfolk fine sandy loam       | 33 | 30 | 40 | 55 | 45 |     | 38 | 63 | do   |    | Fair to good.      | do  | Light-colored soils of the forested terraces. Well drained.                       |
| Cahaba very fine sandy loam.  | 33 | 30 | 40 | 50 | 38 | 112 | 32 | 60 | do   |    | do                 |   | Light-colored soils of the forested terraces. Moderately well drained.            |
| Kalmia very fine sandy loam.  | 33 | 30 | 40 | 45 | 38 |     | 38 | 50 | do   |    | do                 | do  | Light-colored soils of the forested uplands. Medium-textured subsoils.            |
| Ruston fine sandy loam        | 33 | 28 | 45 | 55 | 50 |     | 38 | 55 | do   |    | Fair               |   | Light-colored soils of the forested uplands. Moderately well drained.             |
| Kalmia fine sandy loam        | 30 | 30 | 35 | 45 | 50 |     | 32 | 40 | do   |    | do                 | do  | Light-colored soils of the forested uplands. Medium-textured subsoils.            |
| Bowie very fine sandy loam.   | 32 | 28 | 40 | 50 | 45 |     | 38 | 75 | do   |    | Fair to good       |   | Light-colored soils of the forested uplands. Medium-textured subsoils.            |

Fair to good crop-land. Inherent fertility commonly low. Most of these soils respond to management. Productivity medium.

See footnotes at end of table.

TABLE 6.—Productivity ratings of the soils of Choctaw County, Okla.—Continued

| Soil (soil types, phases, complexes, and land types) | Crop productivity index for—  |                        |                        |  |                                |                              |  |                                     |                 |                                |                    | General productivity grade (based on cotton and corn)  | Soil group as shown on map legend  | General classification |
|--|-------------------------------|------------------------|------------------------|--|--------------------------------|------------------------------|--|-------------------------------------|-----------------|--------------------------------|--------------------|--|--|------------------------|
|  | Cotton<br>100=<br>400<br>lbs. | Corn<br>100=<br>50 bu. | Oats<br>100=<br>50 bu. | Grain<br>sor-<br>ghums<br>100=<br>40 bu. | Pea-<br>nuts<br>100=<br>40 bu. | Al-<br>falfa<br>100=<br>4 T. | Sor-<br>ghum<br>forage<br>100=<br>4 T. | Pota-<br>toes<br>100=<br>200<br>bu. | Vege-<br>tables | Prairie<br>hay<br>100=<br>2 T. | Pasture            |  |  |                        |
| Boswell very fine sandy loam.                        | 33                            | 25                     | 30                     | 38                                       | 30                             | -----                        | 32                                     | -----                               | Fair            | -----                          | Fair to good.      | Light-colored soils of the forested uplands. Heavy subsoils. Light-colored soils of the forested terraces. Imperfect to poor drainage. Dark soils of the upland prairies. Deep, medium textured. Light-colored soils of the forested uplands. Medium-textured subsoils. Soils of the bottom lands. Well drained, medium textured, light colored. Light-colored soils of the forested uplands. Heavy subsoils; slow drainage. Light-colored soils of the forested uplands. Light-textured subsoils. Soils of the bottom lands. Well drained, light textured, light colored. Light-colored soils of the forested uplands. Medium-textured subsoils. Soils of the bottom lands. Poorly drained, medium textured, light colored. Shallow, heavy-textured soils. Prairie. Light-colored soils of the forested uplands. Light-textured subsoils. Light-colored soils of the forested terraces. Poorly drained. | Poor to fair cropland and poor to good pastureland. Inherent fertility generally low. Drainage and overflow also limit productivity. |                        |
| Myatt very fine sandy loam. <sup>7</sup>             | 33                            | 25                     | 30                     | 38                                       | 38                             | -----                        | 38                                     | 30                                  | do              | -----                          | Fair to poor.      |  |  |                        |
| Newtonia very fine sandy loam.                       | 30                            | 25                     | 50                     | 50                                       | 38                             | -----                        | 38                                     | 45                                  | do              | 50                             | Good to excellent. |  |  |                        |
| Norfolk fine sandy loam, deep phase.                 | 30                            | 25                     | 30                     | 55                                       | 50                             | -----                        | 32                                     | 50                                  | Good            | -----                          | Fair               |  |  |                        |
| Atkins silt loam, high-bottom phase.                 | 30                            | 25                     | 50                     | 55                                       | -----                          | -----                        | 32                                     | 55                                  | Poor            | -----                          | Poor to fair       |  |  |                        |
| Lufkin very fine sandy loam. <sup>7</sup>            | 33                            | 20                     | 25                     | 38                                       | 30                             | -----                        | 38                                     | 25                                  | do              | -----                          | Poor               |  |  |                        |
| Ruston loamy fine sand                               | 25                            | 25                     | 32                     | 50                                       | 42                             | -----                        | 45                                     | 50                                  | Fair            | -----                          | Fair               |  |  |                        |
| Pope loamy fine sand <sup>8</sup>                    | 25                            | 25                     | 40                     | 50                                       | 30                             | -----                        | 25                                     | 40                                  | do              | -----                          | Poor to fair       |  |  |                        |
| Bowie fine sandy loam                                | 25                            | 25                     | 35                     | 50                                       | 62                             | -----                        | -----                                  | 62                                  | Good            | -----                          | Fair               |  |  |                        |
| Bibb very fine sandy loam. <sup>7</sup>              | 28                            | 20                     | 40                     | 50                                       | 30                             | -----                        | 30                                     | 30                                  | Poor            | -----                          | Poor to fair       |  |  |                        |
| Crockett clay loam                                   | 25                            | 20                     | 40                     | 50                                       | 45                             | 15                           | 30                                     | 40                                  | do              | 50                             | Good to fair       |  |  |                        |
| Norfolk loamy fine sand                              | 25                            | 20                     | 25                     | 38                                       | 38                             | -----                        | 30                                     | 45                                  | Fair            | -----                          | Fair to poor       |  |  |                        |
| Myatt silt loam <sup>7</sup>                         | 25                            | 20                     | 30                     | 38                                       | 30                             | -----                        | 38                                     | 20                                  | Poor            | -----                          | do                 |  |  |                        |

|  |    |    |    |    |    |    |    |      |                |    |   |
|--|----|----|----|----|----|----|----|------|----------------|----|---|
| Atkins silt loam <sup>1</sup> .....          | 25 | 20 | 35 | 45 | 30 | 25 | 25 | do   | Poor to fair.. | 9  | Soils of the bottom lands. Poorly drained, medium textured, light colored.<br>Light-colored soils of the forested terraces. Moderately well drained.<br>Light-colored soils of the forested uplands. Medium-textured subsoils.<br>Soils of the bottom lands. Poorly drained, heavy, light colored.<br>Light-colored soils of the forested terraces. Poorly drained.<br>Light-colored soils of the forested uplands. Medium-textured subsoils. |
| Kalmia fine sand .....                       | 25 | 15 | 30 | 38 | 38 | 30 | 35 | Fair | Poor.....      |    |   |
| Cuthbert fine sandy loam.....                | 20 | 20 | 32 | 30 | 30 | 38 | 30 | do   | Poor to fair.. |    |   |
| Atkins silty clay loam <sup>2</sup> ....     | 20 | 20 | 32 | 45 |    | 25 |    |      | do.....        |    |   |
| Myatt silty clay loam <sup>2</sup> ....      | 20 | 15 | 25 | 38 |    | 30 | 15 | do   | Poor.....      |    |   |
| Kirvin fine sandy loam, rolling phase.       | 15 | 15 | 35 | 40 | 35 | 20 | 30 | Fair | Fair.....      |    |   |
| Cahaba fine sand, steep phase.               |    |    |    |    |    |    |    |      | Poor to fair.. | 10 | Land unsuited to cultivation. Very steep.<br>Land unsuited to cultivation. Stony.<br>do<br>Land unsuited to cultivation. Very steep.<br>do<br>Soils of the bottom lands. Poorly drained, heavy, red, calcareous. Land unsuited for cultivation. Stony.<br>Land unsuited for cultivation. Hilly and stony.<br>do<br>Land unsuited for cultivation.   |
| Crawford stony loam .....                    |    |    |    |    |    |    |    |      | Fair to poor.  |    |   |
| Denton stony clay .....                      |    |    |    |    |    |    |    |      | do             |    |   |
| Susquehanna clay .....                       |    |    |    |    |    |    |    |      | Poor           |    |   |
| Cuthbert fine sandy loam, steep phase.       |    |    |    |    |    |    |    |      | do             |    |   |
| Roebuck clay .....                           |    |    |    |    |    |    |    |      | do             |    |   |
| Pottsville stony fine sandy loam.            |    |    |    |    |    |    |    |      | do             |    |   |
| Rough stony land (Denton soil material)      |    |    |    |    |    |    |    |      | do             |    |   |
| Rough stony land (Pottsville soil material). |    |    |    |    |    |    |    |      | do             |    |   |
| Riverwash.....                               |    |    |    |    |    |    |    |      | Very poor..    |    |   |
|  |    |    |    |    |    |    |    |      |                |    | Generally best suited for forest or grazing land.   |

<sup>1</sup> The soils are listed in the approximate order of their general productivity for cotton and corn under the common practices of soil management, the most productive first.  
<sup>2</sup> The soils are given indexes that indicate the approximate average production of each crop in percentage of the standard of reference. The standard represents the approximate average yield obtained without use of amendments on the more extensive and better soil types of those regions of the United States in which the crop is most widely grown. The indexes are based on estimates of yields (see table), as yield data are too fragmentary to be adequate. Absence of an index shows that the crop is not grown on the particular soil type.  
<sup>3</sup> Data are not sufficient to justify giving indexes for vegetables and pasture. The terms used to describe productivity have local rather than national meaning.  
<sup>4</sup> The standard for prairie hay as used in Choctaw County is 2 tons. A standard of 1 ton has been used in areas of the Great Plains where the hay is chiefly short grasses.  
<sup>5</sup> This is a grouping to indicate the general productivity of the soils under common soil-management practices. In Choctaw County it is based on an average of the indexes for cotton and corn. Refer to the text for further explanation.  
<sup>6</sup> This classification or grouping indicates in a broad and general way the comparative fertility, productivity, and suitability of the soils for cropland, pasture, and forest. The descriptive terms for comparative productivity have local rather than national application.  
<sup>7</sup> These soils are naturally poorly drained. The indexes given are for areas in which some artificial drainage has been provided, or for the naturally better drained areas.  
<sup>8</sup> These soils are subject to rather frequent overflow that damages crops. The yields given are for crops grown during the more favorable seasons.

The ratings in table 6 compare the productivity of each of the soils for each crop to a standard, namely, 100. This standard index represents the approximate average acre yield obtained without amendments on the more extensive and better soil types of the regions of the United States in which the crop is most widely grown. An index of 50 indicates that the soil is about half as productive for the specified crop as the soil with the standard index. Soils given amendments such as lime and commercial fertilizers or special practices such as irrigation, and unusually productive soils of small extent, may have productivity indexes of more than 100 for some crops.

The principal factors affecting the productivity of land are climate, soil (including the many physical, chemical, and biological characteristics), slope, drainage, and management, including the use of amendments. No one of these factors operates separately from the others, though some one may dominate. In fact, the factors listed may be grouped simply as the soil factor and the management factor, since slope, drainage, and most of the aspects of climate may be considered characteristic of any given soil type or phase. Crop yields over a long period furnish the best available summation of the effect of the associated factors, and therefore they are used where available. In Choctaw County most of the indexes are based on estimated yields rather than on actually reported yields, although considerable information was furnished by farmers.

The order in which the soils are listed and the general productivity grade are based on the average of the cotton and corn indexes. These two are the dominant crops of Choctaw County and together occupy from 80 to 90 percent of the cropland. Since it is difficult to measure mathematically either the exact significance of a crop in the agriculture of an area or the importance or suitability of certain soils for particular crops, it is realized that this order may not be entirely satisfactory. The general productivity grade numbers are determined as follows: If the weighted average is between 90 and 100, the soil type is assigned a grade of 1; if it is between 80 and 90, a grade of 2 is given; and so on.

It will be noted that some of the ratings of the soils are rather low in comparison with the better soils of the United States. This is not altogether due to a lack of suitability of the soils of Choctaw County to the crops grown or to a lack of fertility. Irregularity of the moisture supply from year to year and lack of intensive methods of soil management account in part for the comparatively low yields. On the other hand, the fact that a soil is well adapted to a particular crop does not necessarily mean that the crop will be grown extensively on it. Economic considerations, such as relation of the price of the crop to the cost of production and marketing, are of prime importance in determining the use of land. The crop productivity indexes, therefore, are not a result of economics of production. They report production only quantitatively and therefore cannot be interpreted into land values except in a very general way. Distance to market, relative prices of farm products, and other factors influence the value of land.

It is important to realize, moreover, that productivity, as measured by yields, is not the only consideration that determines the relative worth of a soil for growing crops. The ease or difficulty of tillage

and the ease or difficulty with which productivity is maintained are examples of considerations other than productivity that influence the general desirability of the soil for agricultural use. In turn, steepness of slope, presence or absence of stone, drainage conditions, the resistance to tillage offered by the soil because of its consistence or structure, and the size and shape of areas are characteristics of soils that influence the relative ease with which they can be tilled. Likewise, inherent fertility and susceptibility to erosion are characteristics that influence the ease of maintaining soil productivity at a given level. Productivity, as measured by yields, is influenced to some degree by all these and other factors, such as moisture-holding capacity of the soil and its permeability to roots and water, and so they are not factors to be considered entirely separately from productivity; but, on the other hand, schemes of land classification to designate the relative suitability of land for agricultural use must give some separate recognition to them. In Choctaw County infestation of the boll weevil is another factor of considerable influence on the productivity of cotton.

The right-hand column of table 6 summarizes in a simple way the productivity and suitability for use of the various soils by placing them in a few groups on the basis of their relative suitability for cropland, pasture, and forest. The column "Soil group as shown on map legend," brings out the soil characteristics that have been used in grouping the soils by colors on the soil map.

Productivity tables do not present the relative roles that soil types, because of their extent and the pattern of their distribution, play in the agriculture of the county. The tables characterize the relative productivity of the individual soil types for specific crops. They cannot picture the total quantitative production of crops by soil areas without the additional knowledge of the acreage of the individual soil types devoted to each of the specified crops.

## RECOMMENDATIONS FOR THE MANAGEMENT OF THE SOILS OF CHOCTAW COUNTY <sup>8</sup>

A high percentage of the soils of the uplands in this county are low in natural fertility. More than half of the farms in the area contain less than 70 acres each, and less than 2 percent are larger than 380 acres each. Because of a marked variation in the physical character of different soil types, opportunities for soil improvement are not equal. Soils that have relatively impervious clay subsoils do not respond to good management like soils having subsoils that provide more favorable conditions for moisture movement and root development. On areas where soil erosion has removed a high percentage of the surface soil, it will be difficult to increase crop yields without the use of phosphate and other fertilizers, because the average subsoil is lower in available plant nutrients than the surface soil. The relative cost of fertilizer treatment as compared with the value of the increase in crop yield obtained as a result of fertilization is an important economic factor affecting recommendations that may be made for the purpose of improving the productive capacity of the land. Crop production regulates farm income under average condi-

<sup>8</sup> By H. J. Harper, professor of soils, Agronomy Department, Oklahoma Agricultural and Mechanical College.

tions, and low crop yields on small farms are conducive to a relatively low standard of living. Unless the individuals who own or operate land desire to solve a particular problem, very little progress can be made by providing technical assistance or information.

Although soil conditions in this county are variable, many similar problems of soil management are encountered. Row crops are planted on land regardless of its productivity; consequently, the problem of reducing soil losses as a result of erosion is important on all sloping land that is cultivated. Since climatic possibilities are favorable for the production of high yields when soil fertility is not a limiting factor in plant development, good crop yields will be obtained where large quantities of legume residues were returned to the soil the preceding year.

The problems of pasture improvement on soils of the uplands are similar, although response from treatments vary because differences in soil texture affect the optimum development of grass. Many soils are also acid and low in available plant nutrients, but response to fertilization will not be the same because of differences in the physical structure of the soil. Some general recommendations and information on the chemical composition and changes in these soils are presented in the following paragraphs.

#### ORGANIC MATTER, NITROGEN, AND PHOSPHORUS

The production of row crops, such as corn or cotton, is a soil-depleting system unless a legume crop is grown for soil improvement and fertilizers are applied to replace plant nutrients that are removed when crops are harvested. Every bushel of corn removes approximately 1 pound of nitrogen from the land. Each bale of cotton, including the seed and lint, contains approximately 35 pounds of nitrogen. Since most of the nitrogen in all plants except legumes is obtained from the soil solution as a result of the decay of organic matter in the soil, every farmer should appreciate the importance of using a cropping system that will add nitrogen to the soil, in order to maintain the productive capacity of the land as far as nitrogen and organic matter are concerned. When crop yields decline below the climatic possibilities for a particular region, the use of fertilizers, such as phosphate, limestone, and potash, that will increase the quantity of nitrogen added to a soil by increasing the growth of the legume crop, can be recommended. Planting one row of cowpeas or velvetbeans in alternate rows with corn or grain sorghums is one method used by many farmers to help maintain crop yields. As the nitrogen and organic matter present in the virgin soil disappear, maximum yields of cowpeas and velvetbeans grown in alternate rows with corn should contain enough nitrogen to produce 20 to 30 bushels of corn per acre. This system is essentially a 2-year rotation and should be used on soils of low productivity. One row of legumes between two rows of corn or grain sorghums will produce more corn on many soils than alternate rows of grain and legumes. Whether such a system will maintain yields over an indefinite period depends on the total amount of nitrogen fixed by the legume crop. Dry seasons are less favorable for nitrogen fixation than seasons when rainfall is more abundant. On poor soils, low yields of cowpeas will not

produce an appreciable increase in corn yields. Under such conditions fertilization of the cowpeas with phosphate fertilizer should be recommended in order to increase nitrogen fixation.

The use of legumes to increase the production of cotton has not been practiced extensively; however, some farmers have planted two rows of cotton and one row of cowpeas, a method similar to that frequently used in the production of corn and grain sorghums. Since less nitrogen is required to produce a crop of cotton than a crop of corn, it is easier to maintain cotton yields than to maintain corn yields on the same type of land. This is one reason why fair crops of cotton can be produced on soil that will not produce profitable yields of corn or small grains.

Many of the dark-colored soils of the uplands still contain enough organic matter and nitrogen to produce good yields of corn, cotton, or small grains although no legume crops are grown in the cropping system. Since it is easier to maintain productivity than to improve land after the fertility has been exhausted, legumes such as sweetclover or lespedeza should be grown with small grain where the natural fertility of the soil is favorable for the production of these crops. Conditions are especially favorable for the growth of sweetclover on the Denton and San Saba soils. The Durant soils must be limed before sweetclover can be grown.

Evidence that cropping systems are needed to maintain the organic matter and nitrogen content of cultivated land was obtained by collecting and analyzing 10 composite samples of soils from cultivated fields and 10 additional samples from adjacent areas of virgin land. The average results of these analyses are given in table 7.

TABLE 7.—*Loss of plant nutrients from soils of Choctaw County, Okla., as a result of cultivation*

[Average of 10 comparisons]

| Condition of soil | Nitrogen                     | Organic matter                | Total phosphorus           | Readily available phosphorus |
|-------------------|------------------------------|-------------------------------|----------------------------|------------------------------|
| Virgin.....       | Pounds <sup>1</sup><br>2,400 | Pounds <sup>1</sup><br>51,400 | Pounds <sup>1</sup><br>380 | Pounds <sup>1</sup><br>48    |
| Cropped.....      | 1,490                        | 33,800                        | 300                        | 42                           |
| Loss.....         | 910                          | 17,600                        | 80                         | 6                            |

<sup>1</sup> Pounds per acre in soil 6 $\frac{3}{4}$  inches deep.

The analyses given in table 7 show that approximately one-third of the nitrogen and organic matter has disappeared as a result of cultivation. The nitrogen content of these soils is lower than the average for the State. The total phosphorus content also is low. Approximately 20 percent of this element has been removed as a result of crop production and loss of soil by erosion. The average composition of these soils is slightly higher than the average composition of 12 additional samples of surface soil collected from cultivated fields located in different parts of the county. The average composition of these 12 cultivated soils calculated on a basis of 1 acre, 6 $\frac{3}{4}$  inches deep, was as follows: Nitrogen, 1,320 pounds; phosphorus, 340 pounds; and readily available phosphorus, 30 pounds, which is low for this element. From

these chemical studies it appears that the problem of maintaining the nitrogen content of a high percentage of the cultivated land in this county is one of the important problems in connection with the maintenance of crop production at a profitable level, since other analyses show that the average nitrogen content of the cultivated land in this area is lower than in counties where a higher percentage of the soils has developed under the influence of prairie vegetation.

Experiments conducted in this county indicate that grain crops, legumes, and cotton will respond to phosphorus fertilization when this element is the primary limiting factor in plant development. The majority of the soils of the uplands and some of the soils developed on stream terraces are deficient in available phosphorus. A study of 122 samples of surface soil collected from different parts of Choctaw County indicates that 31 samples were very high in readily available phosphorus, 15 samples were high, 17 samples were medium, 30 were low, and 29 were very low in this important element. The problem of soil improvement on many soils cannot be solved by the application of a phosphate fertilizer unless a legume crop is grown in a cropping system, in order to add nitrogen to the soil. Strongly acid sandy soils of the upland are deficient in potash in many places, and cotton leaf rust has been observed on many of these soils. Under such conditions a fertilizer containing potash should be used to provide sufficient potassium to prevent the appearance of rust on the leaves and to control the destructive effect of cotton wilt when this disease is present in the soil.

#### SOIL REACTION

A study of the chemical composition of virgin soils in this county indicates that a marked variation occurs in the acidity in different horizons of the soil profile. Since a high percentage of the root system of most plants except trees is found within a few inches of the surface of the ground, the composition of the surface layers of soil has an important influence on plant development. Under natural conditions plant residues accumulate on or near the surface of the ground, and as the organic matter decays, the mineral matter is liberated in a readily available form for use by succeeding vegetation. Tillage alters this condition, especially when row crops are grown. On sloping land large quantities of soil have been lost by erosion, exposing acid subsoils, which are lower in available plant nutrients than the surface soils. Although corn, cotton, cowpeas, grain sorghums, and many other crops are acid tolerant, crop yields decline on eroded land because of the decrease in the availability of plant nutrients that takes place as an indirect effect of the increase in acidity and the exploitive system of land use.

A study of 154 samples of surface soil collected from different parts of the county indicates that 33 were well supplied with lime, 40 were neutral in reaction and would grow good sweetclover without an application of ground limestone, 40 were slightly acid, 20 were medium acid, and 21 were strongly acid. Corn will respond to lime on strongly acid soils when a good supply of organic matter and other plant nutrients are present. A good supply of lime in the soil favors the more rapid decomposition of soil organic matter, which supplies available nitrogen for plant development. Although peanuts will grow

on soils that are deficient in available phosphorus, this crop frequently responds to row applications of finely ground limestone because the crop has a high calcium requirement. As cowpeas and velvetbeans can be grown on acid soil, cropping systems can be developed on the sandier soils, which will supply nitrogen needed for crop production at a minimum expense for fertilizers such as phosphorus and potash. Where these nutrients cannot be supplied, crop yields will continue to decline, and the only alternative will be to discontinue the production of cultivated crops and use the land for pasture.

Some of the dark-colored soils of the uplands and bottom lands are not acid. Lime-loving crops, such as alfalfa and sweetclover, can be grown on them. These soils have a distinct advantage so far as the cost of crop production is concerned, because yields can be maintained by planting the legumes at regular intervals in a crop rotation. In most places soil fertility can be produced in a soil at a lower cost than it can be supplied to the land in the form of commercial fertilizers or ground limestone; consequently, neutral or basic soils should have a higher potential value than medium to strongly acid soils, other factors being equal.

#### SOIL AND WATER CONSERVATION

Loss of surface soil by erosion is a serious problem on sloping land where row crops are grown and no attempt is made to regulate the rate of run-off. No accurate data are available on the total area of land that has been abandoned as a result of loss of fertility by sheet and gully erosion, but the total acreage is high, and this loss has created a serious problem in some communities by reducing tax income. The continued production of cotton and corn without regard to the direction of the rows has been responsible for this condition to a very great extent. Construction of terrace ridges and contour farming greatly retard loss of soil by regulating the rate of run-off during periods of torrential rainfall. Loss of organic matter also decreases the rate of infiltration of rain, and eroded land washes more rapidly than soil well supplied with decaying organic matter, because of an increase in the percentage of rainfall lost by run-off. Many of the upland soils have relatively impervious subsoils. Loss of surface soil from these areas is a more serious problem than from areas where friable subsoils occur. Shallow soils suffer from drought and also from too much rain, especially the nearly level areas because of their limited water-holding capacity. Shallow soils with friable subsoils can be improved by good farming practices although much of the surface soil has been removed by erosion; consequently more effective use of labor can be obtained by selecting a soil that will respond to various treatments that may be required to improve crop production. The use of small grains in cropping systems to increase the protective cover on the land during periods of more abundant rainfall aids materially in reducing soil loss from sloping uplands, but lack of machinery needed to plant and harvest the small grains limits the use of such crops on many farms. Soil conservation practices are of little value after the greater part of the soil material has been lost. Reclamation must take place under such conditions, and this is an expensive process. The cooperative effort of every landowner and operator is needed to protect the soil that remains on the rolling upland of this county, in order to preserve it for the use of the present and future generations.

## CROPPING SYSTEMS AND SOIL IMPROVEMENT

Although cotton and corn are the major crops produced in this section, farmers and landowners who realize that legumes must be grown to maintain the productivity of cultivated land can develop a farm program that will conserve the soil and improve crop production. Soils that contain enough calcium, phosphorus, and other plant nutrients to grow alfalfa or sweetclover are easily handled by a rotation such as corn, cotton, small grain, and sweetclover, because no immediate investment for fertilizer is required to maintain the nitrogen and organic matter in these soils.

Dual cropping also can be practiced on many soils by planting lespedeza or sweetclover in the small-grain fields in a continuous cropping system or planting cowpeas on the land after the small grain is harvested. Cowpeas or velvetbeans in alternate rows with corn will aid in maintaining corn yields, provided sufficient fertilizer or natural soil fertility will produce at least 1½ tons of legume residue per acre, which can be either pastured or plowed under in the fall or winter, so that the residues will decay and supply nitrogen to the succeeding crop. A legume crop should not be harvested for hay if maximum benefits are to be obtained. Fertilizers applied to cotton or corn may indirectly affect the growth of legumes, because more phosphorus is usually applied than corn or cotton will utilize. Legume crops planted after a crop has been fertilized will obtain some benefit from the residual effect of the fertilizer treatment. Fertilizers may also be applied, in order to increase the yield of the legume, and the succeeding crop will obtain its phosphorus and nitrogen from the decay of the organic matter.

Cowpeas resistant to nematodes may be needed on some sandy soils. The Iron and Brabham varieties of cowpeas are superior to many other varieties for this purpose. Varieties of cotton that have produced the highest yields in experimental tests and have a good length of staple include Stoneville, Rowden, and Delta & Pine Land strains. Experiments conducted on several soil types in southeastern Oklahoma indicate that 1 pound of fertilizer will produce approximately 1 pound of seed cotton when the rate of fertilization is 200 pounds of a 4-12-4<sup>9</sup> per acre.

On sandy land low in available phosphorus, peanuts will produce a fair crop without fertilization. Many peanut growers remove the vines from the land when the peanuts are harvested. Such a procedure destroys more organic matter than the continuous production of cotton and cannot be continued for many years without a noticeable reduction in crop yield. A winter cover crop of rye should be used to protect the surface of land for peanuts from wind and water erosion during the winter. Crotalaria or cowpeas planted after the rye is harvested or cut for hay will add nitrogen, which is removed when the peanut crop is harvested, and these residues should be plowed under in late winter or early spring, in order to provide a more favorable condition for the production of peanuts the following year.

On areas of bottom land affected by floodwaters during the spring and early summer, grain sorghums or June corn can be planted, if

<sup>9</sup> Percentages, respectively, of nitrogen, phosphoric acid, and potash.

Johnson grass is not a serious problem, during the latter part of June or early in July without much hazard from overflow during the rest of the growing season. Such a practice will reduce the hazards of crop production occurring from early spring planting on land because of overflows, which are most likely to take place during the spring.

#### DRAINAGE FOR SOIL IMPROVEMENT

Many soils on the bottom lands or on the uplands with very little slope suffer from excessive quantities of moisture when rainfall is abundant. Soils of the uplands can be improved by the construction of terrace ridges to act as drainage channels and prevent the accumulation in low areas of excessive quantities of water, which saturates the soil and prevents normal development of plants. On some areas of bottom land diversion ditches are needed to prevent the accumulation of water from adjacent slopes and also to allow the escape of overflow water from these areas when floods occur. Soils of the uplands and many bottom-land soils occurring in comparatively level areas in sections of abundant rainfall generally have poor internal drainage unless the soil is very sandy in the subsurface layers. The Lufkin soil is a good example of this condition occurring on the upland. Where impervious subsoils prevent or greatly retard the downward movement of excessive quantities of water through the soil, it is well to use narrow backfurrows located with a level and plowed toward the center ridge for several years so that excessive rainfall can accumulate in the dead furrows and flow out of the field. On some areas of bottom land where frequent overflow occurs, the production of pecans and of timber for posts may be the best method of land utilization.

#### PASTURE IMPROVEMENT

Since a very high percentage of the soils in Choctaw County are either too shallow to support cultivated crops or have been abandoned as a result of soil erosion, the problem of pasture improvement is rather important, because immediate income cannot be obtained from these lands by reforestation, and most of these soils will produce some grazing if a proper system of management is used. Although the potential fertility in many of the light-colored timbered soils is low, as far as the entire soil is concerned, frequently the topmost inch of soil is well supplied with phosphorus, calcium, and other nutrients needed for plant development. Such a condition favors the growth of hop clover, black medic, lespedeza, and many introduced grasses. Where pastures are burned each year, a loss of organic matter will occur; consequently, one of the important things that must be practiced in a pasture-improvement program is the prevention of burning. Weeds and brush can be controlled by clipping or by grazing with sheep and goats. Mowing sprouts soon after a vigorous growth has taken place each spring will reduce root reserves, and the grass cover on cut-over lands can be increased appreciably by reducing undesirable species of vegetation that compete with the grass for moisture and sunlight. Because native grass is comparatively low in phosphorus and lime and animals frequently suffer because of mineral deficiency when grazed on soils producing grasses that are low in minerals, an attempt should be made to introduce some legumes in every pasture, if they are not

already present, in order to provide forage containing a higher percentage of lime and phosphorus. Although weeds contain more ash than grasses, weeds should be replaced by legumes if possible in order to increase the nitrogen, which is needed in most soils to produce a more vigorous growth of grass. Hop clover and black medic are two excellent legumes, which do not compete appreciably with Bermuda grass or other summer grasses for water. Hop clover will grow on comparatively poor soils, whereas black medic is adapted to the limestone land or medium- to fine-textured soils to which lime has been applied.

Bermuda grass and lespedeza provide excellent grazing where the fertility of the soil is not too low. On poorly drained land, especially bottom land, that is subject to overflow, lespedeza will provide good summer grazing if weeds and grass are clipped at frequent intervals. An attempt should also be made to introduce some of the southern grasses that can withstand the comparatively unfavorable conditions that prevail. Johnson grass can survive on poorly drained land where Bermuda grass will be destroyed by standing water. Some of the poorly drained bottom lands are acid and are low in available phosphorus. Under such conditions it may be difficult to obtain a good stand of legumes on these soils without the use of phosphate fertilizers and correcting the acidity by the addition of finely ground limestone. Such a procedure would be rather expensive and cannot be recommended unless the increase in carrying capacity would be sufficient to more than pay for the cost of soil treatment.

Bermuda grass is especially adapted to soils where accumulations of sand occur as a result of overflow. On poor sandy soils or soils that are too high in clay content, Bermuda grass will not survive in competition with other vegetation having a lower nutrient requirement. Pasture is one of the cheapest methods of providing an adequate source of feed for livestock, and a good grass cover protects the land from the destructive effects of run-off. In a section where small areas of cultivated land occur among larger areas of land not suitable for cultivation, a pasture-improvement program will provide an excellent opportunity to increase farm income by increasing the number of livestock that can be maintained per unit area. A 12-month grazing program is not an impossibility in Choctaw County, if Sudax grass and small grains are used for supplemental grazing when improved pastures are dormant during periods of cold weather or severe summer drought.

#### CHEMICAL COMPOSITION

The chemical composition of a soil is only one of many factors affecting plant development. Soils that contain small quantities of the different plant nutrients, however, cannot produce good crop yields over a long period without fertilization. The results of chemical analyses, made on different profiles collected from typical areas of soil in Choctaw County, are given in table 8.

TABLE 8.—Chemical composition of soils in Choctaw County, Okla.

DARK-COLORED SOILS OF THE UPLANDS

| Soil type and sample No.       | Location                                    | Depth         | pH  | Organic matter | Total nitrogen | Total phosphorus | Readily available phosphorus |
|--------------------------------|---|---------------|-----|----------------|----------------|------------------|------------------------------|
|                                |   | <i>Inches</i> |     | <i>Percent</i> | <i>Percent</i> | <i>Percent</i>   | <i>Parts per million</i>     |
| Choctaw very fine sandy loam:  | SW $\frac{1}{4}$ sec. 17, T. 7 S., R. 14 E. | 0 - 2         | 5.5 | 2.04           | 0.095          | 0.016            | 4                            |
| 6402                           |   | 2 - 15        | 5.0 | 1.22           | .065           | .012             | 2                            |
| 6403                           |   | 15 - 26       | 4.5 | .88            | .043           | .012             | 0                            |
| 6404                           |   | 26 - 36       | 5.9 | .60            | .035           | .010             | 0                            |
| 6406                           |   | 36+           | 7.3 | .35            | .026           | .009             | 2                            |
| Denton clay, shallow phase:    | NE $\frac{1}{4}$ sec. 2, T. 6 S., R. 15 E.  | 0 - 6         | 8.0 | 6.56           | .317           | .056             | 0                            |
| 5893                           |   | 6 - 10        | 8.1 | 3.93           | .200           | .037             | 4                            |
| 5894                           |   | 10+           | 8.3 | 1.63           | .097           | .023             | 0                            |
| Newtonia very fine sandy loam: | NE $\frac{1}{4}$ sec. 18, T. 5 S., R. 15 E. | 0 - 1         | 7.0 | 3.91           | .193           | .027             | 40                           |
| 5854                           |   | 1 - 3         | 6.2 | 1.40           | .134           | .022             | 10                           |
| 5855                           |   | 3 - 8         | 5.4 | 1.10           | .055           | .012             | 12                           |
| 5856                           |   | 8 - 16        | 6.5 | 1.30           | .070           | .014             | 0                            |
| Newtonia silt loam:            | NW $\frac{1}{4}$ sec. 22, T. 5 S., R. 16 E. | 0 - 4         | 6.7 | 3.14           | .129           | .024             | 10                           |
| 5859                           |   | 4 - 12        | 6.6 | 3.08           | .126           | .023             | 0                            |
| 5860                           |   | 12 - 18       | 5.9 | 2.34           | .103           | .022             | 8                            |
| 5861                           |   | 18 - 36       | 5.4 | 1.57           | .087           | .024             | 0                            |
| Durant silt loam:              | Sec. 30, T. 5 S., R. 16 E.                  | 0 - 2         | 6.3 | 3.93           | .157           | .018             | 8                            |
| 5863                           |   | 2 - 8         | 5.8 | 1.71           | .084           | .015             | 0                            |
| 5864                           |   | 8 - 14        | 5.8 | .92            | .048           | .012             | 0                            |
| 5865                           |   | 14 - 22       | 6.8 | 1.22           | .071           | .012             | 0                            |
| 5866                           |   | 22 - 32       | 8.0 | 1.01           | .060           | .009             | 0                            |
| 5867                           |   | 32 - 54       | 8.0 | .21            | .022           | .011             | 14                           |
| Durant silty clay loam:        | Sec. 30, T. 5 S., R. 16 E.                  | 0 - 2         | 6.1 | 5.33           | .218           | .022             | 12                           |
| 5869                           |   | 2 - 10        | 5.8 | 3.28           | .141           | .018             | 8                            |
| 5870                           |   | 10 - 14       | 5.8 | 1.49           | .067           | .012             | 2                            |
| 5871                           |   | 14 - 30       | 6.4 | 1.19           | .064           | .012             | 0                            |
| 5872                           |   | 30 - 48       | 7.0 | 1.03           | .052           | .006             | 0                            |
| Durant silt loam:              | SE $\frac{1}{4}$ sec. 30, T. 5 S., R. 16 E. | 0 - 6         | 5.4 | 1.66           | .061           | .016             | 8                            |
| 6110                           |   | 6 - 15        | 4.7 | 1.03           | .071           | .011             | 2                            |
| 6111                           |   | 15 - 34       | 5.3 | .76            | .052           | .009             | 0                            |
| 6112                           |   | 34 - 50       | 6.8 | .36            | .039           | .005             | 0                            |

LIGHT-COLORED SOILS OF THE UPLANDS

|                               |   |                      |     |      |       |       |    |
|-------------------------------|---|----------------------|-----|------|-------|-------|----|
| Boswell very fine sandy loam: | SE $\frac{1}{4}$ sec. 4, T. 6 S., R. 15 E.  | 0 - 4                | 7.0 | 1.21 | 0.053 | 0.009 | 12 |
| 6123                          |   | 4 - 8                | 6.7 | .29  | .021  | .008  | 4  |
| 6124                          |   | 8 - 15               | 4.6 | .60  | .032  | .006  | 2  |
| 6125                          |   | 15 - 24              | 4.3 | .66  | .035  | .016  | 4  |
| 6126                          |   | 24 - 36              | 4.5 | .29  | .029  | .007  | 2  |
| 6127                          |   | 36+                  | 4.5 | .17  | .015  | .007  | 2  |
| Bowie fine sandy loam:        | Center sec. 34, T. 6 S., R. 17 E.           | 0 - 1 $\frac{1}{2}$  | 6.7 | 2.35 | .081  | .015  | 24 |
| 6379                          |   | 1 $\frac{1}{2}$ - 16 | 6.5 | .27  | .015  | .006  | 2  |
| 6380                          |   | 16 - 26              | 5.0 | .20  | .029  | .011  | 4  |
| 6381                          |   | 26 - 40              | 4.5 | .12  | .022  | .009  | 4  |
| 6382                          |   | 40+                  | 4.7 | .17  | .014  | .007  | 2  |
| Bowie very fine sandy loam:   | NE $\frac{1}{4}$ sec. 32, T. 6 S., R. 17 E. | 0 - 4                | 6.5 | 1.08 | .045  | .014  | 4  |
| 6001                          |   | 4 - 8                | 6.8 | .51  | .031  | .010  | 0  |
| 6002                          |   | 8 - 18               | 5.1 | .41  | .033  | .012  | 0  |
| 6003                          |   | 18 - 30              | 4.4 | .28  | .036  | .014  | 0  |
| 6004                          |   | 30 - 50              | 4.8 | .15  | .020  | .012  | 0  |
| 6005                          |   |                      |     |      |       |       |    |
| Bowie very fine sandy loam:   | NE $\frac{1}{4}$ sec. 32, T. 6 S., R. 17 E. | 0 - 1                | 5.4 | 5.85 | .176  | .028  | 14 |
| 5845                          |   | 1 - 6                | 5.3 | 1.41 | .051  | .016  | 8  |
| 5846                          |   | 6 - 10               | 5.4 | .32  | .025  | .010  | 4  |
| 5847                          |   | 10 - 18              | 5.1 | .17  | .025  | .010  | 4  |
| 5848                          |   | 18 - 28              | 4.8 | .17  | .026  | .011  | 4  |
| 5849                          |   | 28 - 36              | 5.0 | .35  | .030  | .010  | 4  |
| 5850                          |   | 36 - 42              | 5.1 | .17  | .020  | .007  | 2  |
| 5851                          |   | 42 - 74              | 4.2 | .11  | .025  | .007  | 2  |
| 5852                          |   |                      |     |      |       |       |    |
| 5853                          |   |                      |     |      |       |       |    |

TABLE 8.—Chemical composition of soils in Choctaw County, Okla.—Continued

LIGHT-COLORED SOILS OF THE UPLANDS—Continued

| Soil type and sample No.             | Location                                    | Depth               | pH  | Organic matter | Total nitrogen | Total phosphorus | Readily available phosphorus |
|--------------------------------------|---|---------------------|-----|----------------|----------------|------------------|------------------------------|
|                                      |   | <i>Inches</i>       |     | <i>Percent</i> | <i>Percent</i> | <i>Percent</i>   | <i>Parts per million</i>     |
| Cuthbert fine sandy loam:            | NE $\frac{1}{4}$ sec. 16, T. 5 S., R. 15 E. | 0 - 1 $\frac{1}{2}$ | 6.1 | 4.95           | .094           | .018             | 26                           |
| 5832                                 |   | 1 $\frac{1}{2}$ - 6 | 6.6 | 1.52           | .053           | .010             | 12                           |
| 5833                                 |   | 6 - 14              | 4.6 | .56            | .036           | .015             | 8                            |
| 5834                                 |   | 14 - 30             | 4.3 | .22            | .024           | .008             | 0                            |
| 5835                                 |   | 30+                 | 4.4 | .12            | .019           | .009             | 0                            |
| Kirvin fine sandy loam:              | NW $\frac{1}{4}$ sec. 5, T. 7 S., R. 18 E.  | 0 - 1               | 6.8 | 4.50           | .145           | .030             | 48                           |
| 5883                                 |   | 1 - 4               | 6.2 | 1.28           | .043           | .024             | 10                           |
| 5884                                 |   | 4 - 14              | 6.7 | .90            | .040           | .017             | 6                            |
| 5885                                 |   | 14 - 30             | 5.3 | -----          | -----          | .021             | 4                            |
| 5886                                 |   | 30 - 42             | 5.4 | -----          | -----          | .020             | 4                            |
| 5887                                 |   | 42 - 58             | 5.6 | -----          | -----          | .041             | 8                            |
| Lufkin very fine sandy loam:         | NW $\frac{1}{4}$ sec. 9, T. 7 S., R. 18 E.  | 0 - 1               | 6.0 | 4.07           | .134           | .021             | 14                           |
| 5811                                 |   | 1 - 5               | 5.0 | .51            | .033           | .012             | 4                            |
| 5812                                 |   | 5 - 10              | 4.4 | .32            | .028           | .010             | 0                            |
| 5813                                 |   | 10 - 54             | 4.2 | .46            | .033           | .008             | 0                            |
| Norfolk fine sandy loam, deep phase: | NW $\frac{1}{4}$ sec. 10, T. 5 S., R. 16 E. | 0 - 6               | 6.5 | .69            | .020           | .030             | 12                           |
| 5965                                 |   | 6 - 12              | 7.2 | .27            | .011           | .005             | 0                            |
| 5966                                 |   | 12 - 22             | 7.3 | .06            | .012           | .004             | 2                            |
| 5971                                 |   | 22 - 32             | 6.3 | .19            | .023           | .004             | 0                            |
| 5972                                 |   | 32 - 40             | 4.7 | .22            | .033           | .005             | 2                            |
| Sawyer very fine sandy loam:         | NE $\frac{1}{4}$ sec. 24, T. 6 S., R. 18 E. | 0 - 2               | 6.1 | 2.28           | .099           | .015             | 4                            |
| 6305                                 |   | 2 - 5               | 4.7 | 1.16           | .052           | .013             | 4                            |
| 6306                                 |   | 5 - 12              | 4.6 | .38            | .028           | .009             | 2                            |
| 6307                                 |   | 12 - 18             | 4.4 | .18            | .018           | .008             | 2                            |
| 6308                                 |   | 18 - 38             | 5.0 | .40            | .036           | .007             | 2                            |
| 6309                                 |   | 38+                 | 4.5 | .20            | .024           | .005             | 2                            |

SOILS OF THE TERRACES AND BOTTOM LANDS

|                                      |   |         |     |       |       |       |     |
|--------------------------------------|---|---------|-----|-------|-------|-------|-----|
| Atkins silt loam:                    | NE $\frac{1}{4}$ sec. 29, T. 5 S., R. 18 E. | 0 - 1   | 6.1 | 6.59  | 0.226 | 0.045 | 18  |
| 5954                                 |   | 1 - 10  | 5.1 | 1.82  | .092  | .029  | 8   |
| 5955                                 |   | 10 - 22 | 5.1 | .93   | .061  | .022  | 6   |
| 5956                                 |   | 22 - 34 | 5.1 | .58   | .061  | .022  | 8   |
| Atkins silty clay loam:              | NE $\frac{1}{4}$ sec. 29, T. 5 S., R. 18 E. | 0 - 1   | 5.3 | 7.94  | .308  | .080  | 44  |
| 5976                                 |   | 1 - 10  | 4.7 | 1.51  | .087  | .045  | 30  |
| 5977                                 |   | 10 - 20 | 4.7 | 1.07  | .081  | .038  | 12  |
| 5978                                 |   | 20 - 40 | 5.1 | 1.01  | .064  | .039  | 14  |
| Atkins silt loam, high-bottom phase: | NE $\frac{1}{4}$ sec. 17, T. 5 S., R. 18 E. | 0 - 8   | 5.6 | 3.43  | .140  | .045  | 22  |
| 6009                                 |   | 8 - 18  | 4.7 | .34   | .014  | .022  | 0   |
| 6010                                 |   | 18 - 30 | 5.0 | .55   | .043  | .024  | 2   |
| Brewer silty clay loam:              | SW $\frac{1}{4}$ sec. 32, T. 7 S., R. 18 E. | 0 - 4   | 7.1 | 5.67  | .221  | .052  | 200 |
| 5816                                 |   | 4 - 14  | 7.3 | 2.76  | .109  | .031  | 100 |
| 5817                                 |   | 14 - 36 | 7.1 | 1.53  | .053  | .023  | 90  |
| 5818                                 |   | 36 - 42 | 8.3 | 1.40  | .053  | .023  | 120 |
| Cababa very fine sandy loam:         | SW $\frac{1}{4}$ sec. 20, T. 5 S., R. 18 E. | 0 - 4   | 6.6 | 1.81  | .059  | .020  | 14  |
| 6056                                 |   | 4 - 12  | 6.0 | .32   | .014  | .010  | 4   |
| 6057                                 |   | 12 - 18 | 5.4 | .23   | .014  | .011  | 4   |
| 6058                                 |   | 18 - 36 | 5.0 | .33   | .033  | .016  | 8   |
| 6059                                 |   | 36 - 64 | 4.5 | .15   | .033  | .017  | 4   |
| Kalmia very fine sandy loam:         | SE $\frac{1}{4}$ sec. 2., T. 8 S., R. 18 E. | 0 - 1   | 7.5 | 4.79  | .198  | .030  | 42  |
| 5902                                 |   | 1 - 4   | 6.9 | 3.18  | .099  | .021  | 10  |
| 5903                                 |   | 4 - 12  | 6.4 | .33   | .022  | .008  | 0   |
| 5904                                 |   | 12 - 15 | 5.9 | ----- | ----- | .008  | 0   |
| 5905                                 |   | 15 - 24 | 5.4 | .27   | .025  | .008  | 2   |
| 5906                                 |   | 24 - 34 | 5.5 | .20   | .032  | .006  | 0   |
| 5907                                 |   | 34 - 64 | 5.5 | .13   | .029  | .006  | 0   |
| 5908                                 |   |         |     |       |       |       |     |

TABLE 8.—Chemical composition of soils in Choctaw County, Okla.—Continued

SOILS OF THE TERRACES AND BOTTOM LANDS—Continued

| Soil type and sample No.                 | Location                                    | Depth         | pH  | Organic matter | Total nitrogen | Total phosphorus | Readily available phosphorus |
|--|---|---------------|-----|----------------|----------------|------------------|------------------------------|
|  |   | <i>Inches</i> |     | <i>Percent</i> | <i>Percent</i> | <i>Percent</i>   | <i>Parts per million</i>     |
| <b>Kaufman clay:</b>                     |   |               |     |                |                |                  |                              |
| 5981                                     | SE $\frac{1}{4}$ sec. 7, T. 7 S., R. 16 E.  | 0 - 2         | 6.8 | 10.06          | .364           | .067             | 100                          |
| 5982                                     |   | 2 -16         | 5.9 | 2.15           | .118           | .034             | 40                           |
| 5983                                     |   | 16 -30        | 6.0 | 1.15           | .077           | .024             | 38                           |
| 5984                                     |   | 30 -60        | 7.6 | .65            | .058           | .029             | 90                           |
|  |   |               |     |                |                |                  |                              |
| <b>Lonoke silty clay loam:</b>           |   |               |     |                |                |                  |                              |
| 6038                                     | NE $\frac{1}{4}$ sec. 1, T. 8 S., R. 17 E.  | 0 - 8         | 7.3 | 3.47           | .137           | .046             | 52                           |
| 6039                                     |   | 8 -18         | 6.7 | 1.60           | .078           | .025             | 20                           |
| 6040                                     |   | 18 -38        | 7.0 | .97            | .047           | .018             | 4                            |
| 6041                                     |   | 38 -50        | 6.9 | .54            | .033           | .012             | 8                            |
| <b>Lonoke clay:</b>                      |   |               |     |                |                |                  |                              |
| 6017                                     | NW $\frac{1}{4}$ sec. 6, T. 8 S., R. 18 E.  | 0 - 7         | 7.5 | 3.77           | .137           | .049             | 60                           |
| 6018                                     |   | 7 -14         | 7.0 | 1.90           | .078           | .027             | 44                           |
| 6019                                     |   | 14 -24        | 6.5 | 1.07           | .047           | .028             | 20                           |
| 6020                                     |   | 24 -40        | 6.5 | .80            | .033           | .018             | 38                           |
| 6021                                     |   | 40 -52        | 7.0 | .58            | .021           | .012             | 20                           |
| <b>Miller silty clay loam:</b>           |   |               |     |                |                |                  |                              |
| 6012                                     | NE $\frac{1}{4}$ sec. 33, T. 7 S., R. 17 E. | 0 - 8         | 7.8 | 2.05           | .101           | .055             | 130                          |
| 6013                                     |   | 8 -18         | 7.7 | 1.10           | .065           | .044             | 130                          |
| 6014                                     |   | 18 -30        | 7.7 | .91            | .053           | .046             | 60                           |
| 6015                                     |   | 30 -66        | 7.8 | .82            | .047           | .042             | 50                           |
| <b>Miller clay:</b>                      |   |               |     |                |                |                  |                              |
| 5985                                     | NE $\frac{1}{4}$ sec. 8, T. 8 S., R. 18 E.  | 0 - 8         | 7.7 | 3.25           | .147           | .075             | 190                          |
| 5986                                     |   | 8 -24         | 7.6 | 3.23           | .114           | .073             | 190                          |
| 5987                                     |   | 24 -40        | 8.3 | .76            | .075           | .058             | 140                          |
| 5988                                     |   | 40 -54        | 8.0 | .71            | .064           | .058             | 140                          |
| <b>Myatt silt loam:</b>                  |   |               |     |                |                |                  |                              |
| 5821                                     | NW $\frac{1}{4}$ sec. 26, T. 7 S., R. 17 E. | 0 - 1         | 4.9 | 5.68           | .173           | .027             | 20                           |
| 5822                                     |   | 1 - 5         | 5.1 | 1.60           | .060           | .013             | 14                           |
| 5823                                     |   | 5 -10         | 5.4 | .63            | .035           | .008             | 8                            |
| 5824                                     |   | 10 -40        | 4.9 | .38            | .033           | .007             | 4                            |
| 5825                                     |   | 40 -58        | 4.6 | .53            | .068           | .007             | 2                            |
| <b>Myatt very fine sandy loam:</b>       |   |               |     |                |                |                  |                              |
| 6045                                     | SE $\frac{1}{4}$ sec. 24, T. 7 S., R. 17 E. | 0 - 1         | 6.0 | 5.90           | .173           | .026             | 8                            |
| 6046                                     |   | 1 - 5         | 5.2 | 1.74           | .064           | .013             | 0                            |
| 6047                                     |   | 5 -14         | 4.5 | .59            | .028           | .015             | 0                            |
| 6048                                     |   | 14 -27        | 4.7 | .26            | .014           | .007             | 2                            |
| 6049                                     |   | 27+           | 4.9 | .23            | .036           | .007             | 0                            |
| <b>Myatt silty clay loam:</b>            |   |               |     |                |                |                  |                              |
| 5827                                     | NW $\frac{1}{4}$ sec. 25, T. 7 S., R. 17 E. | 0 - 1         | 5.7 | 4.24           | .136           | .020             | 20                           |
| 5828                                     |   | 1 - 5         | 5.8 | 1.63           | .053           | .012             | 8                            |
| 5829                                     |   | 5 -32         | 4.9 | .75            | .039           | .007             | 16                           |
| 5830                                     |   | 32 -55        | 6.0 | .30            | .031           | .005             | 6                            |
| <b>Ochlockonee very fine sandy loam:</b> |   |               |     |                |                |                  |                              |
| 6006                                     | SW $\frac{1}{4}$ sec. 23, T. 5 S., R. 17 E. | 0 -20         | 6.9 | .23            | .014           | .004             | 4                            |
| 6007                                     |   | 20 -44        | 6.3 | 1.14           | .049           | .014             | 14                           |
| 6008                                     |   | 44 -54        | 5.5 | 2.46           | .103           | .045             | 38                           |
| <b>Pledger clay:</b>                     |   |               |     |                |                |                  |                              |
| 6023                                     | NW $\frac{1}{4}$ sec. 14, T. 7 S., R. 16 E. | 0 - 6         | 6.7 | 3.47           | .133           | .041             | 20                           |
| 6024                                     |   | 6 -14         | 5.9 | 2.24           | .098           | .028             | 12                           |
| 6025                                     |   | 14 -26        | 7.0 | 1.31           | .067           | .033             | 60                           |
| 6026                                     |   | 26 -38        | 8.5 | .58            | .042           | .043             | 60                           |
| 6027                                     |   | 38 -48        | 8.3 | .54            | .039           | .022             | 24                           |
| <b>Pope loamy fine sand:</b>             |   |               |     |                |                |                  |                              |
| 5958                                     | Center sec. 20, T. 5 S., R. 18 E.           | 0 - 8         | 5.8 | 1.57           | .081           | .020             | 14                           |
| 5960                                     |   | 8 -40         | 5.5 | .58            | .038           | .016             | 16                           |
| <b>Pope fine sandy loam:</b>             |   |               |     |                |                |                  |                              |
| 5951                                     | Sec. 20, T. 5 S., R. 18 E.                  | 0 -16         | 5.5 | 1.54           | .078           | .030             | 18                           |
| 5952                                     |   | 16 -42        | 5.6 | .23            | .017           | .008             | 12                           |
| <b>Roebuck clay:</b>                     |   |               |     |                |                |                  |                              |
| 5994                                     | SW $\frac{1}{4}$ sec. 20, T. 7 S., R. 17 E. | 0 -20         | 7.8 | 2.35           | .123           | .054             | 50                           |
| 5995                                     |   | 20 -40        | 8.4 | .82            | .062           | .040             | 74                           |
| 5996                                     |   | 40 -60        | 8.9 | .73            | .042           | .037             | 104                          |
| <b>Roebuck clay:</b>                     |   |               |     |                |                |                  |                              |
| 6034                                     | NE $\frac{1}{4}$ sec. 1, T. 8 S., R. 17 E.  | 0 - 8         | 7.9 | 2.81           | .146           | .063             | 46                           |
| 6035                                     |   | 8 -24         | 8.0 | 1.82           | .112           | .060             | 46                           |
| 6036                                     |   | 24 -42        | 8.3 | 1.55           | .053           | .056             | 16                           |
| 6037                                     |   | 42 -90        | 8.4 | .78            | .048           | .048             | 34                           |
| <b>Teller very fine sandy loam:</b>      |   |               |     |                |                |                  |                              |
| 6077                                     | NE $\frac{1}{4}$ sec. 30, T. 7 S., R. 16 E. | 0 - 8         | 7.2 | 2.55           | .112           | .024             | 24                           |
| 6078                                     |   | 8 -24         | 5.4 | .70            | .045           | .012             | 2                            |
| 6079                                     |   | 24 -36        | 5.1 | .30            | .047           | .010             | 0                            |
| 6080                                     |   | 36 -50        | 5.2 | .08            | .022           | .007             | 0                            |

TABLE 8.—*Chemical composition of soils in Choctaw County, Okla.*—Continued

## SOILS OF THE TERRACES AND BOTTOM LANDS—Continued.

| Soil type and sample No.            | Location                          | Depth         | pH  | Organic matter | Total nitrogen | Total phosphorus | Readily available phosphorus |
|-------------------------------------|-----------------------------------|---------------|-----|----------------|----------------|------------------|------------------------------|
|                                     |                                   | <i>Inches</i> |     | <i>Percent</i> | <i>Percent</i> | <i>Percent</i>   | <i>Parts per million</i>     |
| <b>Yahola loamy very fine sand:</b> |                                   |               |     |                |                |                  |                              |
| 6100.....                           | NE¼ sec. 28, T. 7 S.,<br>R. 17 E. | 0 - 3         | 7.6 | 1.87           | .070           | .024             | 44                           |
| 6101.....                           |                                   | 3 - 12        | 7.8 | .39            | .028           | .022             | 44                           |
| 6102.....                           |                                   | 12 - 42       | 7.7 | .12            | .011           | .018             | 50                           |
| 6103.....                           |                                   | 42 - 60       | 8.5 | .08            | .007           | .011             | 52                           |
| <b>Yahola silty clay loam:</b>      |                                   |               |     |                |                |                  |                              |
| 6051.....                           | Sec. 27, T. 7 S., R. 17 E.        | 0 - 9         | 7.8 | 1.94           | .150           | .044             | 130                          |
| 6052.....                           |                                   | 9 - 16        | 8.2 | .95            | .073           | .039             | 100                          |
| 6053.....                           |                                   | 16 - 42       | 8.6 | .22            | .023           | .030             | 150                          |
| 6054.....                           |                                   | 42 - 56       | 8.5 | .32            | .022           | .034             | 150                          |
| <b>Yahola clay:</b>                 |                                   |               |     |                |                |                  |                              |
| 5990.....                           | NW¼ sec. 9, T. 8 S.,<br>R. 18 E.  | 0 - 12        | 7.9 | 2.31           | .126           | .061             | 160                          |
| 5991.....                           |                                   | 12 - 15       | 8.3 | .37            | .033           | .030             | 120                          |
| 5992.....                           |                                   | 15 - 50       | 8.5 | .19            | .014           | .024             | 108                          |

Since most of these samples were collected from virgin areas, the nitrogen and organic-matter contents in the surface layers are higher than in soils obtained from adjacent areas of cultivated land. One of the characteristic effects of vegetation on soil development, which appears in these analyses, is the accumulation of large quantities of organic matter and nitrogen in the surface soil horizons. Where soil samples were collected to a depth of only 1 or 2 inches, the nitrogen and organic-matter content was several times as high as in the immediate subsurface layers. Some of the dark-colored prairie soils, such as the Denton and San Saba, contain large quantities of organic matter in the deeper soil horizons. Such a condition is favorable for the production of cultivated crops, which can be continued over a long period of time without any appreciable decrease in crop yield.

The nitrogen content of the light-colored soils of the uplands is very low except in the surface layer of the virgin soil, which is generally from 1 to 1½ inches thick. Organic matter accumulated as a result of the partial decay of leaves makes up a considerable part of the soil mass, and conditions are very favorable for the development of shallow-rooted types of vegetation until this layer is destroyed by tillage. When the light-colored forest soils are cleared and put into cultivation, analyses show that the total organic matter of the plowed layer is low; consequently the crop-producing capacity of these soils declines more rapidly than that of the dark-colored prairie soils containing larger quantities of organic matter and nitrogen. In order to maintain the productivity of light-colored soils, a more intensive system of farming must be practiced.

A marked variation is also observed in the nitrogen and organic-matter contents of soils of the stream terraces and bottom lands. The Atkins soils normally are poorly drained, and nitrogen does not accumulate in their lower horizons, as the poor drainage limits the development of plant roots to the surface soil. A similar condition prevails on practically all poorly drained land.

According to the chemical analyses, the potential fertility of Brewer silty clay loam is higher than that of the Lonoke soils. Normally, the

physical characteristics of the Lonoke soils are slightly superior to those of the Brewer soils because of the absence of a dense clay layer in the Lonoke profile. The profile of Ochlockonee fine sandy loam is characteristic of areas through which flow streams originating in sandy upland affected by soil erosion. Many of the flood plains have been covered with sand as a result of frequent overflow, and the present surface of the land is much lower in organic matter and nitrogen than the lower horizons, which developed during a period when the rate of accumulation of sediment from overflow was slower.

The acidity in the soil profiles that have been analyzed varies considerably. The Denton, Newtonia, and San Saba soils are neutral to basic in reaction. All other dark-colored prairie soils are medium to strongly acid. Most of the light-colored soils of the uplands are less acid in the surface layers, and acidity increases with depth. The preserving effect of vegetation explains why less acidity appears in the surface horizons of virgin soils, although some of the subsoils are very acid. When cultivated crops are grown on land for 30 to 40 years, the surface soil gradually loses its lime content and less variation in reaction occurs between different horizons in the soil profile. Applications of finely ground limestone would be needed on all these acid soils for the production of lime-loving crops, the rate depending on the degree of acidity present; under present economic conditions, however, acid-tolerant crops should be grown and only sufficient lime applied to meet the nutrient requirements of these crops.

The soils of the stream terraces are more acid than the soils of the flood plains. The origin and texture of the alluvium and the age of the soil determine to a very great extent whether a soil is acid or nonacid in reaction. In some instances soils on terrace formations have been leached until they are medium to strongly acid. In a region of abundant rainfall, sandy soils that readily absorb water develop an acid condition more rapidly than fine-textured soils, which generally contain more lime and have a higher water-holding capacity.

Alfalfa is adapted to soils that are not acid throughout their profiles. This crop will not make satisfactory growth under normal conditions when the lower horizons of the soil have been thoroughly leached, unless large quantities of fertilizers are applied and mixed with the soil before the alfalfa is seeded. The Yahola and Miller soils, in general, are well supplied with lime. These soils are well adapted for the production of alfalfa when the texture of the surface soil is not too sandy and overflow is not a serious problem.

The readily available phosphorus in the majority of the soils analyzed is very low. The total phosphorus content in the average Oklahoma soil is approximately 0.3 percent. Very few soils in Choctaw County contain this much phosphorus. Soils containing less than 25 or 30 pounds of readily available phosphorus per acre will respond to fertilization. Many soils of the bottom lands are high in readily available phosphorus and contain enough of this element to produce good crops for a long period without phosphorus fertilization. Since the total phosphorus in most of the soils of the uplands and in some of the soils of the terraces and bottom lands is low, eventually phosphorus must be added to these soils, in order to maintain crop production. Crops that have a comparatively short growing season respond

to phosphorus fertilization, but crops that have a long growing period do not. Potatoes and alfalfa require a larger quantity of readily available phosphorus than corn or cotton. Grain sorghums and peanuts produce a good yield on soils that are very low in readily available phosphorus; consequently, as soil fertility declines, there is a tendency to plant those crops that either have a strong feeding power for the relatively unavailable forms of plant nutrients in the soil or have a low-nutrient requirement. When forage having a low-nutrient requirement is grown, animals frequently suffer because they do not obtain enough mineral for body requirements in the feed that they consume. Mineral-deficient soils not only affect crop yields under such conditions but indirectly affect the development of livestock.

The soil is similar in many respects to a machine which cannot operate efficiently unless badly worn or broken parts are replaced. The maintenance of soil fertility is one of the important parts of a farm enterprise, and farmers on poor land must learn how to replace plant nutrients at a minimum cost, in order to compete successfully with crops produced on more fertile soils; or they should change their system of farming, if necessary, to comply with economic forces over which the individual farmer has no control.

### MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of the forces of weathering and soil development on soil materials deposited or accumulated by geological agencies. The characteristics of the soil at any given point depend on the internal soil climate, the native vegetation, the composition of the parent material, and the length of time the forces of soil development have acted on the soil material. Soil climate, in turn, depends on the usual climatic factors of rainfall, temperature, and humidity, and locally it is greatly modified by relief as it affects drainage, aeration, and run-off.

Choctaw County is in southeastern Oklahoma. The zonal soils belong to the Red and Yellow Podzolic and Prairie great soil groups.<sup>10</sup> The county is largely within the northern border of the West Gulf Coastal Plain section of the Coastal Plain physiographic province, but a few outliers of the Ouachita province occur along the northern border. Drainage follows largely a dendritic pattern and is maturely developed except in a few areas. The relief is dominantly gently rolling or rolling; but a few fairly extensive areas are undulating or nearly level, and others are steep and hilly.

The climate is humid warm temperate and has resulted in pedalferric soil development. The mean annual rainfall is about 45 inches. The native vegetation varies with the type of parent rock but is dominantly of oak-hickory forest. The vegetation on shales, limestones, and calcareous clays is dominantly tall grasses, including species of *Andropogon* and other genera.

The geologic materials from which the soils have developed are principally sandy clays, sands, clays, shales, and limestones of the

<sup>10</sup> UNITED STATES BUREAU OF CHEMISTRY AND SOILS. SOIL SURVEY DIVISION. SOILS OF THE UNITED STATES. U. S. Dept. Agr. Yearbook (Soils and Men), pp. 1019-1161, illus. 1938.

Upper and Lower Cretaceous formations and some Quaternary materials. Small areas in the northern part of the county are underlain by interbedded shales and sandstones of Pennsylvanian or Mississippian age. There are also extensive areas of old and recent alluvium, particularly along the Red River Valley.

The normal soils of the forested areas are largely from unconsolidated sandy beds and are fairly typical of the Red and Yellow Podzolic soils. They have a thin yellow or gray sandy A<sub>1</sub> horizon. This grades into a sandy clay B horizon, which is yellow, red, reddish yellow, or mottled, depending on drainage and aeration. This, in turn, grades into the C horizon of coarsely mottled or splotched gray, yellow, and red sandy clays. The entire soil is acid and is leached to such an extent that the soils are inherently low in fertility.

The normal Prairie soils are characterized by a thick dark A horizon grading into a gray, yellow, and red mottled heavy subsoil. Both surface soil and subsoil are slightly acid. These soils are fairly well supplied with plant nutrients. Some soils of the grasslands are thin and calcareous and represent Rendzina types, although some of them have red subsoils and are somewhat similar to members of the Reddish Prairie group.

A typical mature Podzolic soil of the area is Bowie very fine sandy loam. This soil is developed from sandy clays of the Cretaceous formations under a forest vegetation and occurs in undulating well-drained areas. Following is a description of a virgin profile of this soil observed one-tenth of a mile south of the northeast corner of sec. 32, T. 6 S., R. 17 E.:

- 0 to 1 inch, grayish-brown very fine sandy loam.
- 1 to 6 inches, light grayish-brown very fine sandy loam faintly mottled with small spots of yellowish brown and containing a few dark soft pellets.
- 6 to 10 inches, light grayish-yellow very fine sandy loam.
- 10 to 18 inches, yellow friable fine sandy clay containing spots of light yellow.
- 18 to 28 inches, light grayish-yellow heavy silty clay loam or sandy clay, mottled with red and bright red.
- 28 to 36 inches, gray silty clay or sandy clay, mottled with red and bright red.
- 36 to 42 inches, gray friable silty clay loam or sandy clay, mottled with red.
- 42 to 74 inches, gray silty clay or sandy clay, mottled with rust brown, red, and yellowish red.

Both the surface soil and the subsoil are acid.

A normal Prairie soil in this county is Choctaw very fine sandy loam. This soil has developed from shaly clays and clays that are slightly calcareous and are members of the Washita group of Lower Cretaceous age. The native vegetation is tall grasses, principally species of *Andropogon*. This soil occupies undulating areas and is moderately well drained. Following is a description of a virgin profile observed about 6 miles north of Forney School:

- 0 to 8 inches, grayish-brown or dark grayish-brown very fine sandy loam, about neutral in reaction.
- 8 to 20 inches, yellow very fine sandy loam with gray mottlings, acid in reaction.
- 20 to 32 inches, yellow crumbly fine sandy clay loam with gray mottlings and rust-brown spots and splotches, acid in reaction.
- 32 to 40 inches, mottled gray and yellow heavy crumbly clay with rust-brown splotches and some fine black spherical concretions, which is strongly acid.
- 40 to 55 inches, yellow dense clay with light-gray and reddish-yellow mottling or splotches and black concretions.

This soil is much less extensive than the Durant soils, which are more or less Prairie soils but could be considered at least partly intrazonal. The Durant soils are intermediate between typical Prairie soils and Planosols. These soils are developed from slightly calcareous shaly clays and clays of Lower Cretaceous age. They occupy undulating areas and are moderately well drained at the surface and slowly drained in the subsoil layers. The native vegetation is tall grasses, dominantly of *Andropogon* species. Following is a description of a profile of Durant silt loam, observed 4½ miles west of Hugo:

- 0 to 10 inches, grayish-brown very fine sandy loam, which is not calcareous and is friable but not granular. When moist the material is rather dark, but when dry it is distinctly gray.
- 10 to 12 inches, light-gray or almost white silt loam. This is a distinct gray layer, which grades abruptly into or rests directly on the layer below.
- 12 to 40 inches, dark brownish-yellow or yellowish-brown heavy tough clay with gray mottling and, in places, some red mottling. This material is not granular, but when moist it separates readily into fine, sharp, angular particles.

The parent material of shale or clay lies several feet below the surface. Fine spherical black concretions and flat, angular, slick sandstone or ironstone fragments occur throughout the surface soil and subsoil. Gypsum crystals are in the subsoil in places.

The most important intrazonal groups are the Rendzinas and Planosols. The Rendzinas are represented by the San Saba and Denton soils, which are developed from fossiliferous limestones of Lower Cretaceous age. The highly calcareous parent rock has delayed the maturity of these soils. The Denton soils are brown or dark brown and are not deeply developed. The native vegetation consists of blue-stem grasses. These soils occupy undulating to gently rolling areas. Following is a description of a profile of Denton clay, shallow phase, about one-half mile north of Forney School:

- 0 to 10 inches, brown or dark-brown calcareous crumbly and slightly granular clay.
- 10 to 18 inches, yellow or gray highly calcareous friable clay grading into partly disintegrated fossiliferous limestone.

The San Saba soils are more deeply developed and are darker than the Denton soils.

The true forested Planosols of this county belong to the Lufkin and Myatt series. They are not very extensive. They are characterized by light-gray surface soils and heavy, dense, gray subsoils mottled in the lower part with yellow. They occupy flat surfaces where drainage is very slow. In slightly better drained situations are the Sawyer soils. These are semi-Planosols developed from Cretaceous clays and heavy sandy clays under a forest type of vegetation. Following is a description of a profile of Sawyer very fine sandy loam:

- 0 to 3 inches, gray or grayish-brown very fine sandy loam.
- 3 to 15 inches, gray or grayish-yellow almost structureless very fine sandy loam.
- 15 to 24 inches, yellow fine sandy clay loam or crumbly clay.
- 24 to 36 inches, mottled gray and red tough heavy clay, which is a semiclaypan.
- 36 to 60 inches, gray, yellow, and red mottled clay or heavy sandy clay.

The entire soil mass is acid or strongly acid.

The mechanical analyses of two soils are given in table 9.

TABLE 9.—Mechanical analyses of two soils from Choctaw County, Okla.

| Soil type and sample No.       | Depth         | Fine gravel    | Coarse sand    | Medium sand    | Fine sand      | Very fine sand | Silt           | Clay           |
|--------------------------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
|                                |               | Percent        |
| <b>Bowie fine sandy loam:</b>  | <i>Inches</i> | <i>Percent</i> |
| 4525154.....                   | 0-1           | 0.2            | 0.3            | 1.4            | 42.6           | 26.7           | 25.4           | 3.4            |
| 4525155.....                   | 1-16          | .1             | .1             | 1.1            | 43.3           | 24.4           | 26.9           | 4.1            |
| 4525156.....                   | 16-29         | .1             | .1             | 1.2            | 34.7           | 19.3           | 21.6           | 23.0           |
| 4525157.....                   | 26-40         | .4             | .2             | 1.0            | 34.2           | 20.5           | 21.1           | 22.6           |
| 4525158.....                   | 40+           | .2             | .1             | 1.1            | 37.7           | 23.4           | 23.1           | 14.4           |
| <b>Ruston fine sandy loam:</b> |               |                |                |                |                |                |                |                |
| 4525159.....                   | 0-3           | .1             | 2.5            | 11.3           | 39.0           | 9.9            | 32.3           | 4.9            |
| 4525160.....                   | 3-12          | .1             | 2.2            | 10.6           | 36.9           | 9.9            | 31.6           | 8.7            |
| 4525161.....                   | 12-25         | .2             | 1.9            | 9.4            | 34.5           | 9.4            | 30.5           | 14.1           |
| 4525162.....                   | 25+           | .4             | 1.7            | 9.0            | 35.9           | 9.6            | 28.9           | 14.5           |

Table 10 is a tabular descriptive summary of the soils of Choctaw County indicating their parent material and catenary relationships as influenced by drainage. Family grouping of soils are not attempted, because, in general, only one member of a family is present in the county. Exceptions to this are as follows: Lufkin family (Lufkin and Myatt soils); Atkins family (Atkins and Bibb soils); Norfolk family (Norfolk and Kalmia soils); and Pope family (Pope and Ochlockonee soils).

TABLE 10.—Tabular descriptive summary of catenary relationships of soils of Choctaw County, Okla.

| Parent materials  | Surface drainage conditions |                  |                  |  |
|---|-----------------------------|------------------|------------------|--|
|   | Poor                        | Fair             | Good             | Excessive                                    |
| Pennsylvanian or Mississippian periods:<br>Interbedded sandstones and shales.....             |                             |                  | Pottsville.....  | Rough stony land (Pottsville soil material). |
| Lower Cretaceous period:<br>Calcareous parent rocks:<br>Limestones (Caddo).....               |                             | San Saba.....    | Denton.....      | Rough stony land (Denton soil material).     |
| Limestones (Goodland).....  |                             |                  | Newtonia.....    | Crawford.                                    |
| Shales and shaly clays.....   |                             | Durant.....      | Choctaw.....     | Crockett.                                    |
| Noncalcareous rocks:<br>Trinity sands and sandy clays.....                                    |                             |                  | Norfolk.....     | Cuthbert.                                    |
| Woodbine formations:<br>Clays and heavy sandy clays.....                                      | Lufkin.....                 | Sawyer.....      | Boswell.....     | Susquehanna.                                 |
| Light sandy clays and sands.....  |                             |                  | Norfolk.....     | Ruston.                                      |
| Sandy clays.....  |                             | Sawyer.....      | Bowie.....       | Kirvin.                                      |
| Old alluvium of Pleistocene or more recent period:<br>Calcareous sediments.....               | Brewer.....                 | Lonoke.....      | Teller.....      |  |
| Acid sediments.....   | Myatt.....                  |                  | Kalmia.....      | Cahaba.                                      |
| Recent alluvium:<br>Calcareous sediments:<br>Largely from West.....                           | Roebuck.....                | Miller.....      | Yahola.....      |  |
| Mixed.....  |                             | Pledger.....     |                  |  |
| Largely local.....  |                             | Osage.....       |                  |  |
| Neutral or slightly acid prairie sediments:<br>Largely local.....                             | Kautman.....                | Verdigris.....   | Pulaski.....     | Pulaski.                                     |
| Acid sediments:<br>From Ouachitas (sandstone, shales).<br>Local (Trinity and Woodbine sands). | Atkins.....                 |                  | Pope.....        |  |
|   | Bibb.....                   | Ochlockonee..... | Ochlockonee..... |  |

## SUMMARY

Choctaw County comprises an area of 790 square miles, or 505,600 acres, in southeastern Oklahoma. The county, which lies in the northern part of the Gulf Coastal Plain, presents few topographic features other than wide, shallow, valleylike areas and a few isolated hills and ridges in the northeastern part. Physiographically, it consists of three plains separated by narrow, low escarpments extending in a general east-west direction. The northern and southern plains have a native forest growth consisting principally of oak and hickory, and the middle plain has a grass cover largely of tall and short bunchgrasses. All the land is drained by the Red River and its tributaries.

The first settlement of white men was in 1824, at the time of the establishment of Fort Towson. Early settlements were made largely by Indians of the Choctaw Nation. Most of the white settlers came after statehood was established in 1907.

The population of the county, according to the 1940 census, is 28,358. Hugo, the county seat, has a population of 5,909. Transportation facilities are good, and rural mail-delivery routes reach almost all parts.

The climate is well suited for a large variety of crops. The mean annual precipitation is 42.55 inches, and the mean annual temperature is 63.6° F. The average frost-free season extends over a period of 230 days.

Cotton and corn are the principal crops, supplemented by oats, sorghums, peanuts, alfalfa, cowpeas, and native-prairie and Johnson-grass hay. Potatoes, sweetpotatoes, melons, truck crops, and fruit are minor crops. According to the census, about 23.5 percent of the county was in cultivation in 1939, and 62.9 percent was in farms in 1940. The average size of farms in 1940 was 103.7 acres.

The soils and land types are grouped as follows: (1) Light-colored soils of the forested uplands; (2) light-colored soils of the forested terraces; (3) dark-colored soils of the upland prairies; (4) dark-colored soils of the forested terraces; (5) light-colored acid soils of the bottom lands; (6) dark-colored slightly acid soils of the bottom lands; (7) calcareous soils of the bottom lands; and (8) miscellaneous soils and land types unsuited to cultivation.

About 52 percent of the county consists of light-colored soils of the uplands and terraces, which are, in general, suited for cultivation. Nearly 74 percent of the area of light-colored soils has friable subsoils, and the rest has soils with heavy subsoils. Although these light-colored soils are used chiefly for cotton, corn, and forage crops, they are well suited to fruits, vegetables, peanuts, cowpeas, and various other crops, and many of these crops are grown. The soils having friable subsoils are the most productive, but yields are only moderate.

The dark-colored soils of the upland prairies and forested terraces cover about 20 percent of the county. Nearly all of them are more productive than the light-colored soils. They are used chiefly for the production of cotton and corn as cash crops. Oats, alfalfa, prairie hay, forage crops, and other crops are successfully produced.

The soils of the bottom lands are well suited to all crops commonly grown in this section, but corn, cotton, and forage crops are the principal crops. About 17 percent of the county is occupied by these soils. They differ considerably in productiveness.

Miscellaneous soils and land types unsuited to cultivation comprise about 10 percent of the county and are too rough, too stony, or otherwise unsuited for cultivated crops.





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