Series 1935, No. 8. Issued May 1939

Soil Survey

Murray County Oklahoma

By
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and
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UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS
In cooperation with the
Oklahoma Agricultural Experiment Station

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By E. G. FITZPATRICK, Bureau of Chemistry and Soils, United States Department of Agriculture, in Charge, and L. E. ROSE and W. C. BOATRIGHT, Oklahoma Agricultural Experiment Station

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COUNTY SURVEYED

Murray County is in south-central Oklahoma (fig. 1). Sulphur, the county seat, is approximately 80 miles southeast of Oklahoma City. The county is roughly rectangular and has an area of 424 square miles, or 271,360 acres.

This county lies in the transitional belt between the timberland and grassland, where both trees and grasses grow. The southern half consists largely of low stony hills, known as the Arbuckle Mountains. The northern half is a strongly dissected prairie which includes some areas of forest land. Throughout the mountainous or stony areas of the southern part are a few narrow valleys suitable for agricultural purposes. Two comparatively large valleys also cross this section. These are the valleys of Washita River and Oil Creek, both of which follow a southerly course across the county. Most of the drainage is into Washita River. Drainage of the western third of the county flows into Wildhorse Creek in Garvin County and into Caddo Creek in Carter County. These creeks empty into Washita River.

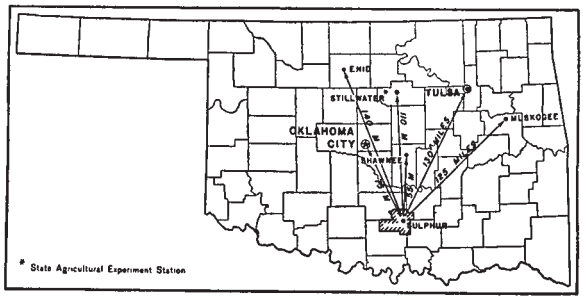

FIGURE 1.—Sketch map showing location of Murray County, Okla.

The northern part is strongly rolling and thoroughly dissected, and there are no remnants of an original plain. The valleys are broadly V-shaped, and the larger streams have carved valleys to a depth ranging from 50 to 75 feet below the level of the surrounding land. Most of this section is prairie, but extensive areas in the central part of it are timbered.

Practically all the land is well drained, but in some bottom land and some old terrace areas poor drainage prevails for a short time after rains or overflows.

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The highest point in the county, approximately 1,400 feet above sea level, is in the East Timbered Hills in the Arbuckle Mountains.[1] The lowest point, about 750 feet above sea level, is at the point where Washita River leaves the county. Sulphur has an elevation of 1,058 feet.

Before settlement, this area was covered largely with prairie types of vegetation. Bluestem is the principal grass, but there is also considerable side-oats grama, blue grama, buffalo grass, Bermuda grass, silver beardgrass, western wheatgrass, wild-rye, and species of *Panicum*. The grasses form a heavy sod on land from which the native vegetation has not been removed.

The upland timbered areas support a thick growth, chiefly of post oak and blackjack oak. Associated with these trees, mostly in the valleys and on the alluvial soils, are a few chinquapin oak, red oak, black oak, bur oak, American (white) elm, winged elm, hackberry, persimmon, hickory, redbud, red mulberry, Osage-orange (commonly called bois d'arc), juniper (*Juniperus virginiana*), ash, sycamore, pecan, black willow (*Salix nigra*), cottonwood, roughleaf dogwood (commonly called small-flowered dogwood), alder, horse-chestnut, black walnut (*Juglans nigra*), coralbean, gum elastic (commonly called chittamwood), red haw, black haw, Chickasaw plum, and sand plum. In general, the trees on the upland areas are small, but on the bottom lands and terraces they are large.

Native flowering plants growing in this section are springbeauty, spiderwort, verbena, plantain, violet, perennial ragweed, ironweed, blazing-star, *Pentstemon* sp., milkweed, psoralea, bladderpod, pokeweed, goldenrod, evening-primrose, anemone, aster (various species), calliopsis, blackberry, bindweed, prairie coneflower, snowberry (locally called Indian currant), buffalo-bur, niggerhead, false-indigo, sandbur or grassbur, pricklypear, purple poppy-mallow, dandelion, thistle, horsetail, Texas croton, Virginia creeper, dayflower, horsemint, locoweed, lupine, *Mentzelia* sp., sheep sorrel, poison-oak, mustard, needlegrass, wild garlic, smartweed, *Salvia* sp., wild onion, sedge, and wild vetch. The most prevalent plants growing in the fields and considered as weeds are Johnson grass, crabgrass, Bermuda grass, pigweed, rescue grass, lambsquarters, Russian-thistle, sunflower, cocklebur, horsenettle, bullnettle, cheat, wild oats, wild-rye, western wheatgrass, and silver beardgrass.

According to Thoburn,[2] the earlier inhabitants of this section probably were the Earth House Indians who built dome-shaped mud-covered wooden-framed buildings. Descendants of these people presumably were the Caddo tribes who lived here at the time North America was being settled by whites.

In 1832, the Chickasaws, who then were living in what is now Mississippi and Alabama, were given the land included in Murray County and several other counties in this section in exchange for their homeland, and the Caddo tribes were forced farther westward. The removal of the Chickasaws to this section took place during the period 1835–47. Settlement was made along Blue River and Boggy

[1] Data on elevations are from topographic sheets of the U. S. Geological Survey.

[2] THOBURN, JOSEPH BRADFIELD. A STANDARD HISTORY OF OKLAHOMA. v. 1. Amer. Hist. Soc. Chicago and New York. 1916. See p. 7.

Creek, which are from 30 to 50 miles southeast of Murray County, and it gradually extended up the bottoms into Murray County. As the Chickasaws were tillers of the soil in their native land, they cleared ground in their new home and became a peaceful agricultural people. The cultivated area of their farms generally was small. Trees were killed by girdling, where necessary, and rail fences were built. Livestock were grazed on the open range. Corn was the principal crop, and cotton and small grains were grown to some extent. Cotton was ginned and spun by hand and used in the home. The Chickasaws had a modern form of government, with a legislature and a governor. Their constitution was adopted in 1856. Tishomingo, which is situated 35 miles southeast of Sulphur, was their capital.

Originally, it was unlawful for the Chickasaws to lease or sell land to white people, who were so anxious to gain a foothold in the fertile valleys that they unlawfully rented land from the Indians and, in many instances, intermarried in order to obtain control of this land. At the time Oklahoma was made a State (1907), however, it became lawful for Indians to sell or lease their allotment to white people who rapidly settled the land. Murray County was organized from a part of the Chickasaw County of Pickens at this time. In 1898, Sulphur consisted of three or four shacks and a post office. Growth was very rapid from that time until 1908. Sulphur was incorporated in 1902.

According to the 1930 census, the population of the county in that year was 12,410. Sulphur, the county seat, is situated approximately 5 miles east of the center of the county, and its population in the same year was 4,242. Another town of importance is Davis, on the main line of the Atchison, Topeka & Santa Fe Railway. It had a population of 1,705 in 1930. Smaller towns are Dougherty, Hickory, and Scullin.

In addition to the Atchison, Topeka & Santa Fe Railway, the county is crossed by a main line of the St. Louis-San Francisco Railway. Sulphur is connected with these two lines by short branch lines. A paved road, United States Highway No. 77, crosses from north to south, connecting Davis with Oklahoma City and Dallas, Tex. A State highway, crossing from east to west, passes through Davis to Sulphur. Another State highway, extending from north to south, passes through Sulphur. Roads are few in the southern part because of its rough, mountainous topography, but most of the valleys are traversed by roads that lead to the better highways. Roads follow most of the section lines in the northern part, and these roads generally are in fair condition and serve as feeders for the main roads.

Electricity is available along some of the main highways and near Sulphur and Davis. Natural gas is available in Sulphur and Davis. Telephone communication is not very common, except along the main highways and in Sulphur, Davis, Dougherty, Hickory, and Scullin. The larger towns have excellent elementary and high schools, but most of the rural schools have only one or two rooms. There are three consolidated schools. The Oklahoma State School for the Deaf is located at Sulphur. Churches are numerous in the larger towns, and schoolhouses are utilized as churches on Sunday in the smaller places.

The most important industries, aside from those related to agriculture, are the quarrying and crushing of limestone for building gravel and the mining of asphalt. The stone quarries are operated intermittently. The production of oil is not important. Some lumbering is carried on. Firewood and fence posts are the most important forest products because of the small size attained by the trees. The other industries carried on are largely related to the utilization of agricultural products, among which the ginning of cotton and the processing of milk are the most important.

Platt National Park is situated at the southern boundary of Sulphur. Aside from its purely scenic character, the park contains a great many mineral-water springs.

CLIMATE

The climate of Murray County is humid and is characterized by warm summers and comparatively short mild winters. The mean annual temperature is 62.7° F. Several brief cold waves, or so-called northers, occur each winter. Occasionally these are accompanied by rain or snow but rarely last over 3 or 4 days at a time. The rainfall is fairly well distributed throughout the year, with April, May, and June the wettest months and February the driest. Occasional droughts reduce yields of crops considerably. The average annual snowfall is very light, and the snow rarely stays on the ground more than 3 or 4 days at a time. Field work may be continued throughout most of the winter except during the short cold spells and following unusual amounts of rain. Destructive hailstorms sometimes damage crops severely in small areas.

Maximum temperatures of 106° F. and minimum temperatures of −3° have been recorded at Sulphur. The average date of the last killing frost is March 28 and of the first is November 2, giving a frost-free period of 219 days. The earliest frost recorded at Sulphur occurred on October 8 and the latest on April 22.

Climatic conditions are favorable for the production of cotton, sorghums, and oats. Corn is one of the principal crops grown, but the climate is not especially favorable for it, owing to occasional droughts, and corn needs an uninterrupted growing period. Fruits and grapes do fairly well in this climate, but late frosts often considerably reduce yields of peaches and apricots. Pecan and sour cherry trees produce well. Early potatoes and most of the common garden crops thrive.

Table 1, compiled from the records of the United States Weather Bureau station at Sulphur, gives in detail the normal monthly, seasonal, and annual temperature and precipitation.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Sulphur, Murray County, Okla.*

[Elevation, 1,011 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1925)	Total amount for the wettest year (1935)
	° *F.*	° *F.*	° *F.*	*Inches*	*Inches*	*Inches*
December	43.3	76	3	2.46	0.32	3.05
January	39.8	70	−3	2.02	.99	1.89
February	46.8	63	11	1.82	.78	.85
Winter	43.3	76	−3	6.30	2.09	5.79
March	54.1	86	20	2.48	.08	5.38
April	63.2	84	29	4.28	2.19	4.31
May	69.0	88	39	5.50	4.83	12.54
Spring	62.1	88	20	12.26	7.10	22.23
June	78.2	101	46	4.13	.02	7.48
July	82.2	105	59	2.70	2.95	2.34
August	82.9	106	52	2.98	1.32	4.14
Summer	81.1	106	46	9.81	4.29	13.96
September	75.8	106	39	3.10	5.08	5.45
October	65.4	93	35	3.75	3.63	3.84
November	52.1	81	21	2.55	1.48	3.09
Fall	64.4	106	21	9.40	10.19	12.38
Year	62.7	106	−3	37.77	23.67	54.36

AGRICULTURAL HISTORY AND STATISTICS

The land included in the county was settled first by cattlemen who grazed large herds of cattle on the open range. Indians, moving westward, settled mainly along the bottoms of the principal streams and cultivated small areas to supplement the food supply obtained from hunting, fishing, and trapping. Later, white people leased land from the Indians or obtained possession of it through intermarriage. The Indians were allowed an allotment of 160 acres merely by putting a fence around it, but larger allotments were permissible on poorer types of land. The early agricultural practices were very primitive, and the cultivated area on each farm was small. Breaking of the native sod was all that was necessary to put the prairie into cultivation.

In 1910, when the first agricultural census was taken of Murray County with its present boundaries, the principal crop was corn. Considerable cotton was grown, and some prairie grass was cut for hay. In 1919, a year following comparatively high prices for cotton, the acreage in cotton overshadowed the acreage in all other crops. Corn and oats ranked next to cotton. Alfalfa hay and native hay (largely Johnson grass) were becoming important crops in the bottoms. In 1929, the acreages in corn and cotton were almost equal, and 5 years later, the acreage in cotton exceeded that in corn, although the acreages of both were reduced. Sorghum crops for hay and grain were also important. The acreage in oats was much less than in 1919.

The total acreage of cropland, according to the census figures, was 70,838 acres in 1924, 63,372 in 1929, and 58,674 in 1934. These figures indicate that the land in this county is being retired from cultivation rapidly. This reduction in cropland is a logical process following its great expansion during the World War.

Table 2 gives the acreage of the more important crops, in stated years, from 1909 to 1934.

TABLE 2.—*Acreage of principal crops in Murray County, Okla., in stated years*

Crop	1909	1919	1929	1934
	Acres	*Acres*	*Acres*	*Acres*
Corn	34,927	16,464	17,761	10,680
Cotton	15,912	34,059	15,056	14,359
Sorghums for grain	60	200	3,619	2,441
Sorghums for silage, hay, and fodder	----------	5,022	3,845	4,475
Oats (grain)	1,170	9,097	3,528	3,888
Oats fed unthreshed	----------	----------	680	879
Wheat	48	6,027	458	899
Alfalfa	223	2,263	1,309	1,570
All other tame hay	810	813	1,475	[1] 5,891
Wild hay	1,868	1,332	2,631	----------
Small grains for hay	195	273	336	1,685
	Trees	*Trees*	*Trees*	*Trees*
Apples	5,990	4,469	2,423	1,799
Peaches	24,005	16,240	10,538	6,846
Pears	588	1,216	1,591	989
Pecans	----------	[2] 16,962	6,848	(3)

[1] Includes wild hay. [2] All nuts. [3] Not reported.

This county includes very extensive areas of rough stony land and rough broken land, which are suited only to the grazing of livestock. According to the 1935 census, there were 16,243 cattle in the county on January 1. Good grade Hereford and Aberdeen Angus are the most common breeds of beef cattle. Dairy cattle are numerous in many sections, and the principal breeds are Holstein-Friesian and Jersey. The numbers of dairy and beef cattle are about equal.

The extensive areas of rough broken land generally are fenced into large pastures ranging from one to six sections in extent. The common practice is to graze the cattle in one pasture during the summer and in another during the winter. The carrying capacity of the ranges is approximately 8 acres to the cow, or 80 head to the section (640 acres). On better types of grazing land the carrying capacity is 5 acres to the cow, or about 130 cattle a section. Some ranchmen feed cottonseed cake during the most severe part of the winter. Small dams are built in each pasture to impound water for use of the cattle during the drier seasons. Windmills are used for pumping in areas where water may be obtained at fairly slight depths. Animal parasites and diseases are not very common. All the dairy cattle are tuberculin tested. Perennial ragweed and wild onion in some pastures cause the flavor of the milk of dairy cattle to be affected during the spring.

Butter and cheese are manufactured locally and shipped to Oklahoma City and nearby markets. Most of the beef cattle are marketed in Oklahoma City and Fort Worth.

The numbers of livestock on farms in census years since 1910 are given in table 3.

TABLE 3.—*Number of livestock on farms in Murray County, Okla., in stated years*

Livestock	1910	1920	1930	1935	Livestock	1910	1920	1930	1935
Cattle	18,834	11,254	13,619	16,243	Sheep	128	231	2,033	340
Horses	3,770	3,189	2,172	1,956	Swine	8,743	6,031	7,736	4,324
Mules	1,506	2,455	1,626	1,507	Chickens	[1] 40,569	54,652	52,223	48,692

[1] All poultry.

Fertilizers are used to a very limited extent. An expenditure of only $190 was reported by three farms in the 1930 census, or $63.33 a farm reporting. Nitrogen and phosphorus fertilizers probably would be of value on many of the soils. Lime would be beneficial for certain crops on timbered upland soils.

Farm labor generally is performed by the farmer and his family, but additional labor occasionally is hired during rush seasons, and it is paid for at the rate of approximately $1 a day. The family of the farmer picks a large part of the cotton. In 1930, 344 farms reported an expenditure of $54,788 for labor, or $159.27 a farm.

According to the United States census for 1935, about 63.3 percent of the farms were operated by tenants, 35.7 percent by owners, and 1 percent by managers. Tenancy was much more prevalent in 1910 because of the practice of leasing land from the Chickasaws. Most of the leases are on a share basis, and the customary lease contract is what is called third-and-fourth, under which the landlord receives one-fourth of the cotton and one-third of the other crops produced and the tenant furnishes all the labor. When the landlord furnishes teams and equipment, he generally receives one-half of the crop. Practically all of the better land in the Washita Valley is farmed by tenants and sharecroppers.

Selected data concerning farms are given in table 4.

TABLE 4.—*Land, farm areas, and operation of farms in Murray County, Okla., in stated years*

Year	Farms	Operated by—			Land in farms			Improved land in farms		
		Tenants	Owners	Managers	Total	Percentage of county area	Per farm	Total	Percentage of farm land	Per farm
	Number	*Percent*	*Percent*	*Percent*	*Acres*	*Percent*	*Acres*	*Acres*	*Percent*	*Acres*
1910	1,218	82.7	17.1	0.2	180,309	66.4	148.0	80,060	44.4	65.7
1920	1,189	58.5	41.0	.5	198,956	73.3	167.3	82,993	41.7	69.8
1930	1,018	61.8	37.6	.6	165,258	60.9	162.3	76,051	46.0	74.7
1935	1,165	63.3	35.7	1.0	184,276	67.9	158.2	65,241	41.3	65.3

The farm buildings are not very pretentious, as a rule. Most of them include a two- or three-room frame house, a small barn, and a chicken house. The average value of farm buildings in 1930 was $803 a farm.

Automobiles and trucks are used on many of the farms, but horse-drawn vehicles are still used, particularly in the rougher areas. The mechanical equipment on the average farm consists of a moldboard plow, lister, spike-tooth harrow, cotton planter, one-row cultivator

or Georgia stock, and wagon. Tractors are few. Work animals include both horses and mules of comparatively light weight. The value of farm equipment in 1930 was $206 a farm.

The value of farm property in census years since 1910 is given in table 5.

TABLE 5.—*Value of farm property in Murray County, Okla., in stated years*

Year	All property		Percentage of value represented by—			
	Per farm	Per acre	Land	Buildings	Implements	Domestic animals
	Dollars	*Dollars*	*Percent*	*Percent*	*Percent*	*Percent*
1910	3,381	22.84	69.4	7.2	2.4	21.0
1920	8,137	48.63	74.0	9.4	3.6	13.0
1930	5,642	34.76	68.2	14.2	3.7	13.9
1935	[1] 2,633	[1] 16.65	[2]	[2]	[2]	[2]

[1] Land and buildings only. [2] Not reported.

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 [3] and its content of lime and salts are determined by simple tests.[4] 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, soils are grouped into mapping units. The three principal ones are (1) series, (2) type, and (3) phase. Areas of land, such as coastal beach or bare rocky mountainsides that have no true soil, are called (4) 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

[3] 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.

[4] 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.

names of places or geographic features near which they were first recognized. Thus, Denton, Osage, and Durant 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, Durant very fine sandy loam and Durant clay loam are soil types within the Durant 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 frequently are 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 a 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, 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[5]

Murray County has a wide diversity of soils despite its small size, owing to the complexity of the outcropping geological materials within its borders, which provide the parent materials of the soils. Most of the upland arable soils have developed from rocks of Pennsylvanian age. These rocks include limestone, limestone conglomerate, granitic conglomerate, sandstone, calcareous sandstone, dolomitic limestone, and cherty conglomerate. Soils and land types classed as nonarable have been developed in part from these rocks and also from pre-Cambrian granitic porphyry and quartzite, and limestones of Cambrian, Ordovician, Silurian, Devonian, and Mississippian ages.[6] Some of the soils have developed from old alluvium.

[5] The soils mapped in Murray County along the Carter County line do not everywhere join similar soils in adjoining areas mapped in Carter County. Some soil separations made in Carter County were not made in Murray County, because of their slight extent, and such areas are included with mapped areas of other soils. The included soils are mainly Zaneis very fine sandy loam, which is included with Newtonia very fine sandy loam; Riverton gravelly loam, included with Gilson gravelly loam; and rough stony land (Hanceville soil material), included with rough stony land (Tishomingo soil material).

[6] U. S. Geological Survey map of Oklahoma, 1926.

The upland soils have developed under both grass and forest types of vegetation, but most of them have developed under grass. The forested soils are confined largely to the sandstone, calcareous granitic conglomerate, and cherty conglomerate formations which occur in the north-central and south-central parts of the county. In general the forested soils of the uplands are light textured and light colored. They are highly leached, are low in organic matter and some essential plant nutrients, and, as a rule, are very acid. They are, therefore, not highly productive. Their content of available phosphorus is low, according to tests made by the Oklahoma Agricultural Experiment Station.

The Prairie soils generally are darker in color than the forested upland soils. They are not so acid and for the most part are more productive than the upland soils developed under forest cover.

The productivity of the upland soils in many places has declined greatly since the land has been put in cultivation, owing to exhaustive cropping and erosion. The relief of most of the county is very rolling or rough, and a large part of the southern half is so rough that the parent materials wash away rapidly, allowing little or no opportunity for soils to develop.

The alluvial soils and soils developed from old alluvial terraces constitute the most valuable soils. They are very fertile, and, where overflow is not excessive, crop yields are comparatively high.

Soils and lands of the miscellaneous nonarable group are in most places mountainous or hilly, as a result of the folding of underlying formations during the uplift of the Arbuckle Mountains in the southwestern half of the county. The oldest of these rocks is pre-Cambrian granite porphyry. Associated with this is Reagan sandstone which is almost quartzite. Lying below this is the Arbuckle limestone which is of Ordovician and Cambrian age. Other limestones of less extent are of Silurian and Devonian age. The more recent materials, from which most of the arable soils are developed, are of Pennsylvanian age.

The agriculture is fairly well diversified, with cotton as the principal cash crop. Corn and oats are the principal feed crops. On the large areas of land, which are too rough or broken for the production of cultivated crops, the chief enterprise is livestock raising.

Most of the soils are moderately heavy in texture and, therefore, probably are better suited to the production of oats and hay than to the other crops commonly grown in this section. Usually, however, a greater net income is derived from the production of cotton, and that is the most important crop. Some of the soils are adapted to corn, but its growth is limited by frequent droughts. Alfalfa and corn are commonly grown with more success on the alluvial soils and soils of the old stream terraces than on the other soils.

The upland soils generally are cropped to cotton and corn. Some oats, grain sorghums, wheat, and peanuts also are grown. The forested upland soils, although not highly productive, are suited to cotton, vegetables, fruits, peanuts, and grain sorghums. The Prairie soils are suited to most of the crops grown in the general area, except peanuts. The most important soils in this county are alluvial soils and soils of old stream terraces, and they are adapted to all the crops mentioned and to alfalfa as well. The nonarable soils generally are utilized for grazing.

Rotation of crops is not a general practice, but the crops grown in many fields are changed occasionally. As a rule, only slight attention is given to crop adaptation in choosing the crop to be grown, except for alfalfa and peanuts. Alfalfa generally is grown only on the alluvial soils and soils of the old stream terraces, and peanuts are grown only on sandy soils. All the soils are fairly well suited to cotton.

The distribution of the different soils throughout the county is largely determined by the character of the geological materials exposed by folding and erosion of the earth's crust. In general, the southern and extreme western parts of the county are mountainous, hilly, and rough, and there is little arable land; the central part consists largely of dark Prairie soils developed from limestone; the eastern part includes a mixture of dolomitic limestone and sandstone soils of light texture; and the extreme northern part is composed of gravelly soils developed from calcareous granitic conglomerate. A wide belt of alluvial soils and soils of old stream terraces occurs in the west-central part in Washita River Valley. Some soils occur in large almost unbroken areas, but most of them do not aggregate a large total acreage. Many soil variations occupy areas so small that they could not be shown separately on the soil map.

The characteristics of the soils are summarized in table 6.

TABLE 6.—*Characteristics of the principal horizons of soils in Murray County, Okla.*

Soil type	Horizon	Thickness	Color	Texture	Reaction [1]	Organic-matter content
		Inches				
Denton clay loam, deep phase.	1	5–7	Dark brown	Clay loam	Neutral	High.
	2	8–12	do	Clay or clay loam	do	Moderate.
	3		Yellowish brown	Clay loam	do	
Summit clay loam	1	10–15	Black	do	do	High.
	2	5–10	Dark brown	Clay or clay loam	do	Moderate.
	3		Yellowish brown	Clay loam	do	
Newtonia very fine sandy loam.	1	5–7	Reddish brown	Very fine sandy loam.	Strongly acid.	Moderate.
	2	6–8	do	Silty clay loam	do	Do.
	3		Yellowish red	do	do	
Roff coarse sandy loam.	1	10–18	Dark brown	Coarse sandy loam	Neutral	Moderate.
	2	(2)				
	3		Brown and rusty brown.	Gravelly loam	Strongly acid.	
Durant fine sandy loam	1	8–15	Dark brown	Fine sandy loan	Neutral	Moderate.
	2	10–14	do	Fine sandy loam or loam.	Slightly acid	Do.
	3		Reddish brown and brown.	Clay loam	Strongly acid.	
Durant very fine sandy loam.	1	8–12	Dark brown	Very fine sandy loam.	Medium acid.	High.
	2	4–6	Dark brown or brown.	Loam or clay loam.	Slightly acid.	Moderate.
	3		Brown and reddish brown.	Clay loam	Strongly acid.	
Grayson clay loam	1	7–10	Very dark brown	do	Medium acid.	High.
	2	4–8	do	do	Strongly acid.	Moderate.
	3		Drab and rusty brown.	Clay	Medium acid.	
Chigley fine sandy loam.	1	2–3	Dark grayish brown.	Fine sandy loam	Neutral	Moderate.
	2	2–4	Yellowish brown	Gravelly fine sandy loam.	Slightly acid.	Very low.
	3		Red or yellowish red.	Clay	Strongly acid.	

[1] Some of the soils listed as neutral are mildly alkaline.
[2] Horizon 2 is lacking in these shallow soils.

TABLE 6.—*Characteristics of the principal horizons of soils in Murray County, Okla.*—Continued

Soil type	Horizon	Thickness	Color	Texture	Reaction	Organic-matter content
		Inches				
Gilson gravelly loam	1	2–3	Dark grayish brown.	Gravelly loam	Neutral	Moderate.
	2	7–10	Yellowish brown	Gravelly fine sandy loam.	Strongly acid.	Very low.
	3	-------	Red or yellowish red.	Gravelly clay	do	
Buckhorn fine sandy loam.	1	5–7	Dark brown or brown.	Fine sandy loam	Neutral	Moderate.
	2	8–10	Brown	do	Slightly acid.	Low.
	3	-------	Reddish brown	Sandy clay loam	do	
Conway fine sandy loam.	1	5–6	Dark grayish brown.	Fine sandy loam	Slightly acid.	Moderate.
	2	10–12	Grayish brown	Fine sand	Medium acid.	Very low.
	3	-------	Yellowish brown	Sandy clay loam	Strongly acid.	
Rough stony land (Denton soil material).	1	1–8	Dark brown and gray.	-------	Neutral	Low.
	2	(1)	-------	-------	-------	
	3	-------	Gray	Stone	-------	
Denton stony loam	1	1–12	Dark brown and gray.	Stony loam	Neutral	Low.
	2	(1)	-------	-------	-------	
	3	-------	Gray	Stone	-------	
Brackett gravelly loam	1	6–8	Grayish brown	Gravelly loam	Neutral	Very low.
	2	(1)	-------	-------	-------	
	3	-------	Chalky gray	Gravelly loam	Neutral	
Chigley gravelly loam	1	2–3	Dark grayish brown.	do	do	Low.
	2	8–10	Yellowish brown	do	Strongly acid.	Very low.
	3	-------	Yellowish brown and rust.	Clay	do	
Rough stony land (Tishomingo soil material)	1	1–8	Brown	-------	-------	Very low.
	2	(1)	-------	-------	-------	
	3	-------	-------	Stone	-------	
Rough broken land (Gilson soil material).	1	1–4	Brown	-------	-------	Low.
	2	(1)	-------	-------	-------	
	3	-------	-------	Stone	-------	
Osage clay loam	1	12–18	Very dark brown	Clay loam	Neutral	High.
	2	12–15	Dark brown	do	do	Moderate.
	3	-------	Dark brown or brown.	do	do	
Verdigris clay loam	1	10–15	Dark brown	do	do	Moderate.
	2	12–15	Brown	do	do	Do.
	3	-------	do	do	do	
Verdigris fine sandy loam.	1	5–10	do	Fine sandy loam	do	Moderate.
	2	10–15	do	Loam	Slightly acid.	Do.
	3	-------	do	Clay loam	Strongly acid.	
Yahola silty clay loam	1	10–18	Reddish brown	Silty clay loam	Neutral	Moderate.
	2	6–10	do	Fine sandy loam	do	Low.
	3	-------	Red	Fine sand	do	
Yahola very fine sandy loam.	1	6–15	Reddish brown	Very fine sandy loam.	do	Moderate.
	2	18–24	do	Fine sandy loam	do	Low.
	3	-------	Red	Very fine sand	do	
McLain silty clay loam.	1	12–20	Dark reddish brown.	Silty clay loam	Slightly acid.	High.
	2	12–18	Brown or black	Clay loam	Neutral	Moderate.
	3	-------	Brown	do	do	
McLain very fine sandy loam.	1	6–15	Dark reddish brown.	Very fine sandy loam.	do	Moderate.
	2	6–8	do	Silty clay loam	Medium acid.	Do.
	3	-------	Brownish red	do	Neutral	
Teller fine sandy loam	1	6–12	Dark reddish brown.	Fine sandy loam	do	Moderate.
	2	12–16	Reddish brown	do	Medium acid.	Low.
	3	-------	Yellowish red	Sandy clay loam	do	
Teller very fine sandy loam.	1	6–12	Dark reddish brown.	Very fine sandy loam.	Neutral	Moderate.
	2	6–16	Yellowish brown	Silt loam or silty clay loam.	Strongly acid.	Low.
	3	-------	Reddish brown	Clay loam	do	

[1] Horizon 2 is lacking in these shallow soils.

TABLE 6.—*Characteristics of the principal horizons of soils in Murray County, Okla.*—Continued

Soil type	Horizon	Thickness	Color	Texture	Reaction	Organic-matter content
		Inches				
Brewer clay	1	10–18	Black	Clay	Neutral	High.
	2	12–15	Dark brown	do	do	Moderate.
	3	-------	Dark brown or brown.	Clay loam	do	
Dougherty very fine sandy loam.	1	10–16	Brown	Very fine sandy loam.	Medium acid.	Low.
	2	6–12	Reddish brown	Clay loam	do	Do.
	3	-------	Brown or reddish brown.	do	Strongly acid.	
Dougherty very fine sandy loam, eroded phase.	1	4– 8	Reddish brown	Very fine sandy loam.	Medium acid.	Low.
	2	10–12	Red	Sandy clay loam	do	Do.
	3	-------	do	Clay loam	do	
Brewer silty clay loam.	1	6–10	Dark grayish brown.	Silty clay loam	do	High.
	2	5–10	Very dark gray	do	Strongly acid.	Moderate.
	3	-------	Yellowish brown	Clay	Medium acid.	

NOTE.—Horizon 3 is, in most soils, the partly weathered or unweathered parent material. Except in the shallow soils, it extends to a depth of 4 feet or more below the surface. In view of this, no definite thickness is assigned to horizon 3.

Table 7 gives the principal factors responsible for the various characteristics of the soils.

TABLE 7.—*Principal factors responsible for the characteristics of soils in Murray County, Okla.*

Soil type	Position	Relief	Susceptibility to erosion [1]	Surface drainage	Internal drainage	Native vegetation	Parent material
Denton clay loam, deep phase	Upland	Undulating	Moderately severe	Good	Good	Prairie	Limestone and marl.
Summit clay loam	do	do	Moderate	Fair	Fair	do	Do.
Newtonia very fine sandy loam	do	do	Moderately severe	Good	do	do	Dolomitic limestone.
Roff coarse sandy loam	do	do	do	do	Good	do	Granitic conglomerate.
Durant fine sandy loam	do	do	Moderate	do	do	do	Calcareous sandstone.
Durant very fine sandy loam	do	do	do	do	do	do	Sandy shale and sandstone.
Grayson clay loam	do	do	Slight	Fair	Restricted	do	Shale.
Chigley fine sandy loam	do	do	Severe	Good	Good	Forest	Granitic conglomerate.
Gilson gravelly loam	do	Rolling	Moderately severe	do	do	do	Sandstone and chert conglomerate.
Buckhorn fine sandy loam	do	Undulating	Moderate	do	do	do	Sandstone.
Conway fine sandy loam	do	Nearly flat	None	Fair	Fair	do	Do.
Rough stony land (Denton soil material).	do	Hilly	Very severe	Excessive	Restricted	Prairie	Limestone.
Denton stony loam	do	Rolling	Severe	Good	do	do	Do.
Brackett gravelly loam	do	do	do	Excessive	Good	do	Limestone and marl.
Chigley gravelly loam	do	Hilly	do	do	do	Forest	Granitic conglomerate.
Rough stony land (Tishomingo soil material).	do	do	Very severe	do	do	do	Granite prophyry.
Rough broken land (Gilson soil material).	do	do	do	do	do	do	Sandstone and cherty conglomerate.
Osage clay loam	Bottom	Slight	Slight	Fair	Restricted	do	Alluvium from prairies.
Verdigris clay loam	do	do	do	do	Fair	do	Do.
Verdigris fine sandy loam	do	do	do	do	Good	do	Do.
Yahola silty clay loam	do	do	do	do	do	do	Alluvium from western prairies and plains.
Yahola very fine sandy loam	do	do	do	do	do	do	Do.
McLain silty clay loam	Terrace	do	None	do	Fair	do	Do.
McLain very fine sandy loam	do	do	do	do	do	do	Do.
Teller fine sandy loam	do	do	do	Good	Good	do	Do.
Teller very fine sandy loam	do	do	do	do	do	do	Do.
Brewer clay	do	do	Slight	Fair	Restricted	do	Old alluvium of mixed origin.
Dougherty very fine sandy loam	do	do	do	Good	Good	do	Do.
Dougherty very fine sandy loam, eroded phase.	do	Rolling	Severe	Excessive	do	do	Do.
Brewer silty clay loam	do	Flat	Slight	Fair	Restricted	Mixed	Do.

[1] These statements refer to the general susceptibility of the soil types and phases to erosion when in cultivated fields and devoted to the production of cotton, even without the aid of terracing, strip cropping, or other erosion preventives.

Figure 2 presents a generalized soil map of the county.

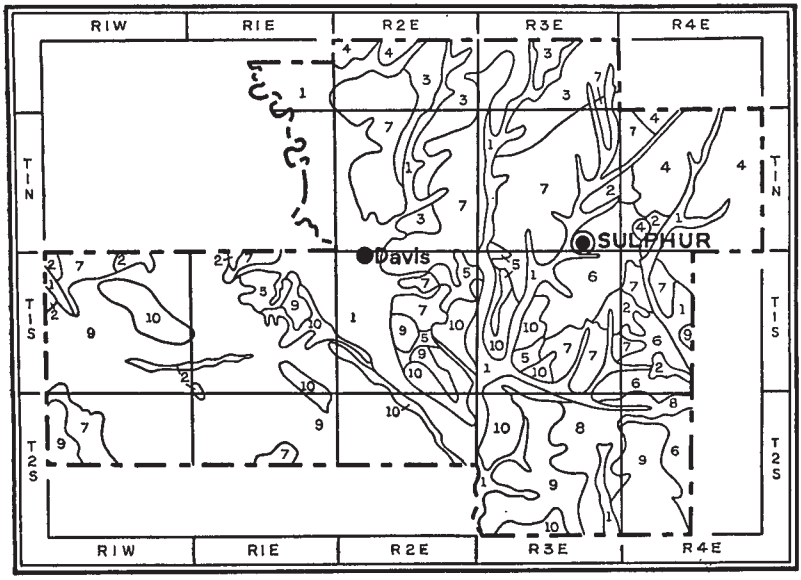

FIGURE 2.—Generalized soil map of Murray County, Okla.: (1) Alluvial soils and terraces; (2) reddish-brown soils—Newtonia; (3) gravelly forested soils developed from granitic conglomerate—Chigley; (4) dark-brown sandy Prairie soils—Durant; (5) gravelly forested soils developed from limestone conglomerate—Gilson; (6) shallow stony soils—Denton stony loam; (7) dark heavy Prairie soils—Denton; (8) dark heavy Prairie soils developed from shale—Grayson; (9) rough stony land, largely limestone rock; and (10) forested rough stony land.

The soils are arranged in four groups on the basis of their relationships in characteristics and their value for crop production, as follows: (1) Arable Prairie soils, (2) arable forested upland soils, (3) alluvial soils and soils of old stream terraces, and (4) nonarable soils and miscellaneous land types. In the following pages these general groups are discussed, and the profile characteristics, relief, drainage, erosibility, general suitability for crops, and other important agricultural features of each soil are described in detail. The acreage and proportionate extent of the soils mapped are given in table 8, and their distribution is shown on the accompanying soil map.

TABLE 8.—*Acreage and proportionate extent of the soils mapped in Murray County, Okla.*

Soil type	Acres	Percent	Soil type	Acres	Percent
Denton clay loam, deep phase	34,624	12.8	Yahola very fine sandy loam	2,496	0.9
Summit clay loam	5,056	1.9	McLain silty clay loam	4,928	1.8
Newtonia very fine sandy loam	9,856	3.6	McLain very fine sandy loam	896	.3
Roff coarse sandy loam	4,160	1.5	Teller fine sandy loam	1,856	.7
Durant fine sandy loam	8,000	3.0	Teller very fine sandy loam	2,688	1.0
Durant very fine sandy loam	5,440	2.0	Brewer clay	3,840	1.4
Grayson clay loam	5,888	2.2	Brewer silty clay loam	1,024	.4
Chigley fine sandy loam	5,824	2.1	Rough stony land (Denton soil material)	79,296	29.2
Gilson gravelly loam	6,080	2.2	Denton stony loam	15,872	5.9
Buckhorn fine sandy loam	2,688	1.0	Brackett gravelly loam	10,624	3.9
Conway fine sandy loam	704	.3	Chigley gravelly loam	9,856	3.6
Dougherty very fine sandy loam	4,224	1.6	Rough stony land (Tishomingo soil material)	8,768	3.2
Dougherty very fine sandy loam, eroded phase	2,624	1.0	Rough broken land (Gilson soil material)	10,688	3.9
Osage clay loam	18,752	6.9			
Verdigris clay loam	1,600	.6	Total	271,360	
Verdigris fine sandy loam	1,152	.4			
Yahola silty clay loam	1,856	.7			

ARABLE PRAIRIE SOILS

The group of arable Prairie soils includes Denton clay loam, deep phase, and all the soils of the Summit, Newtonia, Roff, Durant, and Grayson series mapped in this county. The total acreage of these soils is 73,024 acres, or 27 percent of the total land area. Approximately 65 percent of the Prairie soils is cultivated, and they are recognized as the most productive upland soils in the county. The principal soils included in this group occur in the west-central, north-central, and extreme eastern parts, on the gently undulating divides and gentle slopes in the prairie sections. Their smooth relief is favorable to the use of fairly heavy farm machinery.

These soils have dark-brown or nearly black surface soils from 10 to 16 inches thick, underlain by yellowish-brown, grayish-brown, or reddish-brown clay, clay loam, or sandy clay subsoils. The comparatively dark color of the surface soils indicates a fairly high content of organic matter. These soils are not very highly leached and have a fairly high content of calcium carbonate. Applications of lime are not necessary for the production of alfalfa and most clovers.

In general, these soils are well suited to the production of the general farm crops commonly grown. Unsuitable moisture conditions cause them to be less suitable to alfalfa than soils elsewhere, and their texture causes them to be not highly suited to peanuts, many vegetables, and fruits. Cotton, which is the chief crop, corn, sorghums, oats, cowpeas, early potatoes, and some of the garden crops are the most suitable crops for these soils.

Under virgin conditions these soils supported a good growth of bluestem grasses, and, in places where the native sod remains undisturbed, the pasture and native hay are excellent. In places, the more sloping areas are better suited to native pasture grasses than to cultivated crops.

All these soils are well drained. In unprotected places run-off of rain water is rapid and erosion is excessive. Liming is not needed for most crops, but it may be needed for sweetclover in some places. Commercial fertilizers have not been used to a very great extent on these soils. In places where the soil has been cultivated carefully and the organic-matter content maintained, the inherent fertility of the soil has held up well.

Denton clay loam, deep phase.—Denton clay loam, deep phase, is by far the most important arable soil in Murray County. It is a fairly dark heavy Prairie soil developed from limestone and interbedded calcareous shales and is called locally blackland. The surface soil, to a depth ranging from 6 to 10 inches, is friable dark-brown clay loam or clay, which breaks, on drying, into very fine blocklike clods or granules, most of which are less than one-eighth inch in diameter. It contains a few water-worn quartz gravel. This material grades into brown heavy clay loam or clay, which, on drying, separates naturally into flattened granules or fine clods, from one-fourth to one-half inch in diameter. The granules or fine clods have shiny surfaces. Below a depth of 14 inches, this material grades into brown or yellowish-brown clay loam or clay, which is only slightly lighter colored than that in the horizon above and, when dry, breaks naturally into cubical and irregular clods, from one-

fourth to three-fourths inch in diameter. At a depth of 36 inches, this material, in turn, rests on yellowish-brown and gray mottled highly calcareous clay loam or clay, which is merely weathered limestone and calcareous shales. The soil in the surface layers is neutral in reaction. Hard limestone beds occur in the subsoil at a depth ranging from 4 to 8 feet. In the more sloping areas this soil is more shallow and slightly lighter colored than is typical. In many places, a few hard limestone gravel are present in the surface layer. In the flatter areas the soil is darker than elsewhere and approaches Summit clay loam in character. Included small areas of red soils consist of Newtonia soils.

Denton clay loam, deep phase, has a gently rolling relief and is well drained. The native vegetation consists of bluestem with some side-oats grama, blue grama, black grama, and buffalo grass. These grasses produce a heavy sod under natural conditions.

Approximately 85 percent of the land is in crops, and about 53 percent of the cropland is in cotton, 30 percent in corn, 12 percent in oats, and 5 percent in sorghums. The uncultivated land is in native or reestablished wild-grass pasture. This soil is moderately fertile and is particularly suited to the production of oats. It produces good yields of other crops during seasons of sufficient rainfall. Corn yields range from 10 to 25 bushels an acre; cotton, 100 to 250 pounds of lint; oats, 20 to 50 bushels; and grain sorghums, 15 to 30 bushels. Sorgo yields about 2.5 tons of forage.

This soil is susceptible to erosion because the fine granules of the dried surface soil are moved easily by running water. In many areas, a large part of the valuable surface soil has been lost. Terracing, contour rows, and strip cropping are recommended to prevent this serious loss. The more rolling areas should be left in native pasture.

Comparatively large areas of this soil are associated with Summit clay loam and Brackett gravelly loam in the west-central and north-central parts of the county, principally north and northwest of Sulphur. Its total area is large.

Summit clay loam.—Summit clay loam is a black Prairie soil developed from limestone in gently rolling or nearly flat areas. The surface soil, to a depth of about 13 inches, is very dark gray or black finely granular very friable clay loam containing a few irregular chert and quartzite gravel. It is easily worked under proper conditions of moisture. It grades into dark-brown or very dark brown clay loam or clay, containing a few small chert and quartzite gravel. This material breaks into irregular shiny-surfaced granules or aggregates, from one-eighth to one-half inch in diameter, which are less spherical and larger than those in the surface soil. The fine earth of the aggregates is much lighter colored when crushed. Below a depth of 18 inches, this material passes into yellowish-brown or dark-brown clay loam which rests, at a depth of 23 inches, on yellowish-brown or grayish-brown highly calcareous clay loam or clay. Above a depth of 23 inches, this soil is noncalcareous. Below a depth of 45 inches is light-gray and yellowish-brown variegated highly calcareous clay loam containing numerous small limestone and chert gravel.

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Summit clay loam probably was much more extensive in this county at one time, but erosion, which followed the destruction of the native sod, removed much of the darker surface soil and left the less mature soil which is mapped as Denton clay loam, deep phase. At present, its total area is only 7.9 square miles. The principal bodies are northwest of Sulphur, and a few areas are near Buckhorn School. This soil occupies smooth divides and gentle slopes, and drainage generally is adequate.

Approximately 90 percent of this soil is in cultivation. Of the cultivated land, approximately 45 percent is devoted to corn, 45 percent to cotton, and 10 percent to oats. Yields ranging from 15 to 30 bushels of corn, 125 to 275 pounds of cotton, and about 2.8 tons of sorgo forage an acre are obtained. This is the best upland soil in the county for the production of corn, cotton, and oats. The uncultivated land is in native hay and pasture. The native hay is excellent and yields about 1 ton to the acre. It consists largely of bluestem grass, together with much side-oats grama, some blue grama, buffalo grass, and other grasses.

Because the granules of the dried soil form a loose friable mass easily moved by running water, the soil, where unprotected, suffers rapid sheet erosion. Terracing, strip cropping, and contour cultivation are recommended to protect the soil.

Newtonia very fine sandy loam.—Newtonia very fine sandy loam is a comparatively shallow Prairie soil developed from dolomitic limestone. The 5-inch surface layer is chocolate-brown finely granular very friable very fine sandy loam which is slightly lighter colored when crushed. It grades into dark reddish-brown or red loosely granular silty clay loam or into red crumbly clay. The granules are much darker before they are crushed than is the crushed fine earth which is reddish brown or red. In many places, darker streaks of material from the surface layer reach down into this layer. Below a depth of 11 inches is the subsoil of red or yellowish-red silty clay loam or clay, which breaks, when dry, into small angular granules about one-eighth inch in diameter. This layer rests on solid rock of dolomitic limestone, lying from 3 to 4 feet beneath the surface.

This soil is so closely associated with Denton stony loam and rough stony land (Denton soil material) that it is included with those soils in many large cattle ranches. The small and irregular-shaped fields which, as a rule, would result from the utilization of this soil for crops, discourages its cultivation. Approximately 15 percent of the land is cultivated, of which about 35 percent is in cotton, 35 percent in corn, 15 percent in oats, and 15 percent in sorghums. The uncultivated land is in native pasture. Corn returns yields ranging from 5 to 20 bushels an acre; cotton, 100 to 160 pounds; grain sorghums, 15 to 22 bushels; and oats, 15 to 30 bushels. Sorgo yields 1.7 tons of forage. The native grass is largely bluestem. Stockmen report that about 5 acres are required to support a steer or cow during the year, but during some seasons additional feeding may be necessary.

Some areas of Newtonia very fine sandy loam occur in small valleys, although this is not an alluvial soil. The principal areas are in the eastern part of the county, particularly in the vicinity of Scullin. Small bodies are northeast of Sulphur, east of Nebo, near

Hennepin (which is in Garvin County), and along the divide of the Arbuckle Mountains.

Roff coarse sandy loam.—Roff coarse sandy loam is a grassland soil developed from calcareous granitic conglomerate. This is practically the same rock material from which the Chigley soils are formed. The surface soil is dark-brown loose friable gravelly loam, about 16 inches thick. The gravel material comprises a large quantity of small more or less rounded pebbles of quartzite, quartz, feldspar, and chert. Below this is mottled brown, grayish-brown, and rusty-brown gravelly loam or clay, which changes, below a depth of 32 inches, to yellowish-brown clay loam or gravelly clay. The surface soil is neutral in reaction, whereas the other layers are strongly acid. The fine earth of this soil resembles that of Denton clay loam, deep phase, but it contains a much larger proportion of sand and gravelly material. This soil, therefore, is less productive than the Denton soil.

Approximately 80 percent of this soil is in cultivation, and about 55 percent of the cropland is devoted to cotton, 30 percent to corn, 10 percent to oats, and 5 percent to sorgo, of which the acre yields are from 100 to 165 pounds, 10 to 17 bushels, 15 to 30 bushels, and about 2 tons, respectively. The uncultivated land is largely abandoned land, now covered with wire grass.

Roff coarse sandy loam occurs in the section north and northwest of Sulphur, particularly in the vicinities of Iona and Chigley.

Durant fine sandy loam.—Durant fine sandy loam is a brown Prairie soil developed principally from sandstone or slightly calcareous sandstone. The surface soil, to a depth of 11 inches, is dark-brown loose friable fine sandy loam which, when dry, may be pulverized easily to single grains. In places, small fragments of ferruginous sandstone are scattered over the surface. The upper part of the subsoil is dark-brown fine sandy loam or loam which is heavier and more compact than the surface soil. On drying the exposed material breaks into large prisms or block-shaped clods. The material of this layer appears much lighter in color when crushed. Below a depth of about 22 inches, the subsoil is reddish-brown and yellowish-brown mottled clay loam. This soil is neutral in reaction throughout, although fine particles of calcium carbonate are present in the noncalcareous fine earth in places below a depth of 3 feet.

Approximately 80 percent of this soil is in cultivation, and about 60 percent of the cropped land is in cotton, 25 percent in sorghums, 10 percent in oats, and 5 percent in peanuts. Cotton yields from 75 to 175 pounds to the acre; sorghums, 25 bushels; sorgo, about 2 tons; and oats, 15 to 30 bushels. The rest of the land is in native grass consisting largely of bluestem, with some side-oats grama, blue grama, and buffalo grass. A few trees grow along the small gullies and stream courses in places. This soil is inherently very fertile, but, under the present indifferent methods of cultivation, its natural fertility is being dissipated rapidly by exhaustive cropping and erosion. Terracing, strip cropping, and contour cultivation would prevent much of the severe erosion.

Durant fine sandy loam occurs only in the eastern part of the county, particularly in the vicinities of Scullin, Hickory, and Nebo. The relief is smoothly rolling.

Durant very fine sandy loam.—Durant very fine sandy loam is a dark Prairie soil developed from fine-grained sandstone or sandy limestone. The surface soil, to a depth of 8 inches, is dark-brown friable loam or very fine sandy loam, containing a few smooth rounded quartz gravel. This material pulverizes readily to small grains. There is a subsurface layer of dark-brown and brown mottled heavy loam containing a few fine quartz gravel and brown chert gravel, which extends to a depth of about 11 inches. This is a transitional zone from the surface soil to the subsoil. The material of this layer is lighter colored when crushed. The subsoil is brown and reddish-brown mottled clay loam containing few gravel. Below a depth of 16 inches the material is yellowish-brown, brown, and reddish-brown mottled clay loam. The reaction is neutral to a depth of 38 inches, below which depth the material is brown, reddish-brown, and white mottled highly calcareous clay loam which appears to be weathered calcareous sandstone or sandy limestone. In some places it is definitely derived from sandstone, and in others it is largely from limestone.

Durant very fine sandy loam is a very fertile soil when first put in cultivation, and, if protected from destructive erosion, it retains its fertility well. It is well suited to the principal crops grown in the county, and approximately 75 percent of it is in cultivation. About 45 percent of the cultivated land is in cotton, 35 percent in corn, 10 percent in oats, and 10 percent in sorghums. Cotton yields from 100 to 200 pounds to the acre; corn, 10 to 20 bushels; oats, 12 to 22 bushels; sorgo, 2½ tons; and grain sorghums, 20 to 25 bushels. About 15 percent of the land is covered with native grasses, largely bluestem, together with some side-oats grama, blue grama, and buffalo grass.

The principal areas of this soil are those in the vicinity of Hickory and in the northwestern part of the county near the Garvin County line.

Grayson clay loam.—Grayson clay loam is similar in appearance to Osage clay loam, but it occurs at higher elevations than does that soil. It occupies broad stream valleys, extending to the heads of small streams in many places, and over divides in a few places. This is a dark heavy Prairie soil probably developed largely from shale. The surface soil, to a depth of 8 inches, is very dark brown friable clay loam. Below this is slightly darker and more compact clay loam or clay, continuing to a depth of about 19 inches. In some places, a fairly distinct sprinkling of gray siliceous material is present below this depth, but, in most places, the material is drab clay containing a few rusty-brown spots or mottlings. This is an incipient claypan, and it breaks into blocklike clods. The tops of the prisms do not appear to be rounded. At a depth of 31 inches, this material grades into grayish-brown heavy clay mottled with olive and reddish brown. Below a depth of 42 inches, the subsoil is gray or light-gray clay loam containing rusty-brown spots, white spots of lime, and, probably, some fragments of soft gypsum. The subsoil is calcareous below this depth in some places, but the surface layers are noncalcareous. Calcareous shale underlies the soil at a depth of several feet.

This is a very productive soil, and, as it occurs on gently sloping land, it has not been subject to excessive erosion. This factor has

contributed to maintenance of the soil fertility. In some places, especially in the few "slick spots" or saline spots, the heavy subsoil has injured crops. Practically all of the land is cultivated. Corn, cotton, and oats are the chief crops. Acre yields range from 15 to 40 bushels of corn, 100 to 300 pounds of cotton, and 20 to 50 bushels of oats. Sorgo yields about 2½ tons of forage an acre. The native vegetation probably was largely bluestem, together with some buffalo, blue grama, and side-oats grama grasses.

The principal areas of this soil occur in the vicinity of Nebo and in the valley of Buckhorn Creek.

ARABLE FORESTED UPLAND SOILS

The arable forested upland soils are comparatively light-colored soils which have developed under a forest cover consisting largely of post oak, blackjack oak, and hickory trees. Under virgin conditions these soils have a 2- or 3-inch brown or slightly dark grayish-brown surface layer which is comparatively high in organic-matter content. The dark color disappears when the land has been cultivated for a short time. Below this thin layer is a yellowish-brown or grayish-brown light-textured layer which, in most places, is underlain, at a depth ranging from 10 to 16 inches, by a yellowish-red or yellow gravelly clay or sandy clay subsoil.

These soils are highly leached and are acid in the upper part of the profile. Tests conducted by the Oklahoma Agricultural Experiment Station on these soils indicate that their content of nitrogen, phosphorus, and calcium carbonate is low. The practices of fertilization, liming, crop rotation, and the use of green-manure crops would increase yields of crops on these soils when moisture conditions are favorable.

The relief, in general, is rolling or gently rolling. The surface soils are sandy and, for that reason, are better suited to the use of light machinery than to the use of heavy machinery. Drainage is adequate. Erosion is severe on the unprotected cultivated soils. Strip cropping on the contour has proved very desirable to reduce erosion, but practically no strip cropping is being done at present. A few fields are terraced, but terraces are difficult to hold on these soils, unless some perennial crops are grown on the terrace.

The soils of this group are Chigley fine sandy loam, Gibson gravelly loam, Buckhorn fine sandy loam, Conway fine sandy loam, Dougherty very fine sandy loam, and Dougherty very fine sandy loam, eroded phase. They cover an area of 34.6 square miles, or 8.2 percent of the total area of the county.

The arable forested upland soils are fairly well suited to the production of cotton, sorghums, peanuts, and some fruits and vegetables. Yields, for the most part, are low. Approximately 45 percent of this land is in cultivation.

Chigley fine sandy loam.—Chigley fine sandy loam is a shallow forested soil developed from calcareous granitic conglomerate. The 2-inch surface layer is loose friable fine sandy loam which is dark brown under a cover of native vegetation but becomes grayish brown under cultivation. Below this is pale yellowish-brown gravelly fine sandy loam that is very light colored when dry. Beginning at a depth of about 6 inches and continuing to a depth of 22 inches, the

subsoil is red or yellowish-red sticky clay containing a few fine gravel, largely small rounded quartz and irregular or flattened particles of feldspar and chert. Below a depth of 22 inches is yellowish-red and yellow mottled clay loam which grades, at a depth of 27 inches, into mottled brown, yellow, gray, and black gravelly clay loam. Below a depth of 32 inches the black spots disappear and the gravel becomes more abundant. Consolidated calcareous granitic conglomerate lies at a depth ranging from 4 to 10 feet. Many variations from this typical profile exist, such as a red or black surface soil, clay spots, and gravelly spots a few square feet in extent.

The relief is gently rolling. Fairly thick stands of small blackjack and post oak trees constitute the native vegetation. The underbrush consists almost entirely of young oak, and most of the open patches are covered by bluestem and buffalo grasses.

This soil is strongly acid in most places. It is highly leached and is not considered very fertile. It produces fair crops of kafir, peanuts, and watermelons. Sweetclover does well where the soil is not too acid or where lime is applied. This soil probably would respond very well to phosphate and nitrogen fertilizers and to additions of lime. Approximately 50 percent of the land is in cultivation, of which about 20 percent is in corn, 45 percent in cotton, 10 percent in oats, and 25 percent in sorghums. Cotton yields approximately 60 pounds to the acre; kafir, 15 bushels; and sorgo, about 1 ton.

Chigley fine sandy loam occurs principally in the northern part of the county around Iona and along the breaks of Chigley Sandy Creek.

Gilson gravelly loam.—Gilson gravelly loam is a cherty forested soil which is light colored and developed from a cherty limestone conglomerate. In virgin condition the surface layer, to a depth of 3 inches, is very dark grayish-brown fine sandy loam containing considerable fine subangular and rounded gravel and pebbles of chert and sandstone. This material is very loose, and the dark color soon disappears under cultivation. Below is light-brown or yellowish-brown gravelly fine sandy loam underlain, at a depth of about 14 inches, by yellowish-red or red gravelly clay loam. Both these layers contain gravel of the same type as that in the surface layer. At a depth of about 34 inches, the material changes to reddish-brown and yellowish-brown mottled or spotted gravelly loam which apparently grades into unweathered limestone conglomerate containing a high percentage of chert and sandstone fragments. The calcareous cementing material disintegrates rather rapidly and produces a deep gravelly soil. The soil in several small areas mapped along the base of Arbuckle Mountains and other stony areas differ slightly from the typical soil in mode of formation. The parent materials in these areas are colluvial and, possibly, alluvial-fan materials washed down slopes and accumulated instead of being cemented into a conglomerate as are the parent materials of the typical soil. Otherwise, the included soil seems to be approximately the same as Gilson gravelly loam.

Approximately 45 percent of the land is in cultivation. Of the cultivated land, about 60 percent is in cotton, 15 percent in corn, 20 percent in oats, and 5 percent in sorghums. The soil is not fertile

enough for the successful growing of corn. It is fairly fertile when first cultivated, but the finer material soon is removed by erosion, leaving a coat of gravel on the surface. Cotton returns from 65 to 150 pounds of lint to the acre; corn, 5 to 17 bushels; sorgo, 1¼ tons; and oats, 10 to 30 bushels.

Gilson gravelly loam is sometimes used as a source of gravel for road-building material. In most places, it is associated with rough broken land (Gilson soil material). The principal areas are in the breaks of Big Sandy Creek southwest of Sulphur.

Buckhorn fine sandy loam.—Buckhorn fine sandy loam is a brown forested soil with a red subsoil. The surface layer, to a depth of 5 or 6 inches, is very dark brown loose friable fine sandy loam. Much of the dark color disappears soon after the land is put in cultivation, and the surface soil becomes brown or grayish brown. Below this is loose friable brown fine sandy loam which, at a depth of about 17 inches, grades into reddish-brown weakly cemented sandy clay loam. This material is very hard when dry but friable when moist. Below a depth of 35 inches, the subsoil is yellowish-brown or brownish-red friable fine sandy clay loam containing a few sandstone fragments. Below this, at a depth of about 66 inches, the material is yellow and yellowish-brown mottled fine sand which is largely disintegrated sandstone, and sandstone fragments are numerous in this layer which rests on solid sandstone about 80 inches below the surface.

Although this is a forested soil, it has not been so highly leached as have many such soils. Apparently, the land originally supported a prairie vegetation, and trees have recently encroached on it. Approximately 20 percent of this soil is cultivated, and cotton is the principal crop. Cotton yields from 60 to 130 pounds to the acre and sorgo about 1½ tons. Wind erosion is a problem on the cultivated land. Run-off of rain water, also, often is destructive on this soil during the spring.

The soil is of limited extent. The principal areas are south and southeast of Sulphur.

Conway fine sandy loam.—Conway fine sandy loam is a light-colored forested soil developed from noncalcareous sandstone. The surface soil is about 8 inches thick and consists of dark grayish-brown loose fine sandy loam which becomes very light colored under cultivation. Below this and continuing to a depth of 21 inches is grayish-brown or light-brown fine sand. This is underlain by yellowish-brown fine sandy clay loam which, below a depth of 35 inches, merges with yellowish-brown and reddish-brown mottled fine sandy clay loam. The reaction throughout the profile is acid.

This soil is light textured and highly leached; therefore, it is not very productive. Its light texture also subjects it to wind erosion. About 90 percent of the land is still in the native forest vegetation consisting chiefly of post oak and blackjack oak. The few cultivated areas are cropped mostly to cotton, peanuts, and watermelons. Yields are low, but, with proper fertilization, fair crops may be produced. Peaches and grapes do well on this soil. Cotton yields from about 50 to 75 pounds to the acre; and sorgo, about 1½ tons of forage. In some places the soil is darker and more productive than the typical soil. Here, it approaches Durant fine sandy loam in character.

There are only a few scattered areas of this soil, the largest of which is 1 mile west of Nebo.

Dougherty very fine sandy loam.—Dougherty very fine sandy loam occurs on smoothly rolling or almost flat high terraces along the edge of Washita Valley. A large part of this soil is cultivated, but the few remaining virgin areas indicate that the native vegetation was oak trees.

The surface soil is about 14 inches thick and consists of brown fine sandy loam which is easily cultivated. This material grades into brown or reddish-brown clay loam which, below a depth of about 22 inches, merges with yellowish-brown and red or rusty-brown mottled clay loam. Below a depth of 38 inches, the subsoil is grayish-brown and yellowish-brown mottled clay loam containing a few black spots. Yields on this soil are not so high as those on soils occurring on lower terraces, because the soil has occupied its present position for a longer time and is, therefore, more highly leached. It is included with the group of upland soils because of its well-developed profile.

The crops commonly grown in this section are produced on about 70 percent of the land. Yields of cotton range from 90 to 150 pounds an acre; of corn, 10 to 25 bushels; and of oats, 20 to 40 bushels. Sorgo yields about 1.7 tons and grain sorghums about 20 bushels. Drainage is good. Plate 1, *A*, shows an area of open forest on this soil. The native vegetation appears to have been largely blackjack oak, post oak, elm, hackberry, and chittamwood.

This soil covers an area of 6.6 square miles. The principal areas lie along United States Highway No. 77, north and south of Davis, and a few areas are west of Davis on the west side of Washita River.

Dougherty very fine sandy loam, eroded phase.—Dougherty very fine sandy loam, eroded phase, occurs at the lower edge of old terraces along the edge of the Washita Valley and on the higher terraces which are occupied mainly by Dougherty very fine sandy loam. It apparently was a forested soil, although few trees remain. The native vegetation consists of post oak with some blackjack oak, and bluestem grass in the open spaces.

The surface soil to a depth of 6 inches is dark-brown or chocolate-brown loose and friable very fine sandy loam. It grades into chocolate-brown or brownish-red fine sandy clay loam which, in turn, at a depth of about 11 inches, grades into red sandy clay loam. At a depth of 20 inches, the material is red or brownish-red clay loam containing beds of chert and quartz gravel in places. Red loose very fine sandy loam lies below a depth of 60 inches. The entire soil is acid.

Owing to its shallowness and steeply sloping relief, only about 15 percent of this soil is in cultivation. Yields of cotton range from 60 to 100 pounds an acre.

This soil covers an area of 4.1 square miles, principally along United States Highway No. 77, north of Davis.

ALLUVIAL SOILS AND SOILS OF OLD STREAM TERRACES

The group of alluvial soils and soils of old stream terraces represents soil materials which have been deposited comparatively recently by streams during periods of overflow. Included in this group are

types of the Osage, Verdigris, Yahola, McLain, Teller, and Brewer series. Most of these soils have brown or dark-brown surface soils and dark-brown or reddish-brown subsoils. These are naturally the most fertile, although not always the most productive, soils in the county and all are fairly well supplied with the essential plant nutrients. Yields are uncertain on the lower lying soils because of the danger from overflow, but the soils on the terraces seldom fail to produce fair crops.

The Yahola soils generally are overflowed more often than the other soils. Some Johnson grass is grown for pasture on the Yahola soils, and hay and pecans do well. Some of the better drained and higher lying areas are successfully cropped to alfalfa, corn, cotton, and sorghums. The Osage and Verdigris soils also produce good Johnson-grass pasture and hay, but they are better suited to cultivated crops than are the Yahola soils. Their best utilization is for the production of alfalfa, corn, cotton, oats, sweetclover, and sorghums. The Teller, McLain, and Brewer soils are suited to practically all the crops commonly grown. Teller fine sandy loam and Brewer clay, however, are not so well suited to alfalfa as are the other members of these two series.

Uncleared areas of the alluvial soils provide good pasture for hogs, particularly during fall and winter when nuts and acorns mature. All these soils supported a growth of trees before they were put into cultivation. The soils need neither fertilizers nor lime, but the content of organic matter and nitrogen should be maintained by the use of alfalfa or other legumes in the rotation.

These soils occur in the valleys of Washita River, Chigley Sandy Creek, Big Sandy Creek, Rock Creek, Buckhorn Creek, Oil Creek, Mill Creek, and Colbert Creek. They cover 15.1 percent of the total area of the county.

Osage clay loam.—Osage clay loam is an alluvial soil composed of materials washed largely from dark Prairie soils. It occurs on the flat flood plains along many of the streams and is subject to occasional overflow. The profile of this soil is not uniform because of variations in the conditions under which the soil material is deposited. In general, the surface soil is about 14 inches thick and consists of very dark brown or almost black friable clay loam. This grades into dark-brown somewhat heavier textured and lighter colored clay loam or clay, which passes, at a depth of about 30 inches, into brown clay loam or clay, containing a few chert gravel. At a depth of about 37 inches the material is brown clay loam and contains numerous white spots and fine particles of chert and calcium carbonate. The soil material is very thick, as is characteristic of alluvial soils. Small areas of Verdigris clay loam, which are not of sufficient size to map separately, are included.

Osage clay loam is one of the most fertile soils in the county and as a rule is easily worked despite its heavy texture. About 80 percent of the land is cropland, of which 45 percent is devoted to corn, 35 percent to cotton, 10 percent to alfalfa, and 10 percent to oats. The high content of organic matter and nitrogen in this soil and its extra supply of moisture from higher land and overflow are particularly favorable for the production of corn. These features, together with the thickness of the soil and its high content of bases, are also

very favorable for the production of alfalfa. When overflow is not excessive, corn returns from 20 to 50 bushels to the acre. Alfalfa yields from 2½ to 4 tons; cotton, 100 to 325 pounds; sorgo, about 3 tons of forage; grain sorghum, 18 to 25 bushels; and oats, 20 to 60 bushels. No fertilizers are used or needed, and about the only problems are the eradication of Johnson grass and the prevention of overflow. Levees protect the land from overflow in a few places. Terracing the uplands in the stream watershed probably would reduce overflow.

The uncultivated land is in native forest of water, chinquapin, post, bur, and blackjack oaks, elm, and willow. Native pecan trees are abundant. Some open areas provide fairly good pasturage for hogs and cattle. The grasses include buffalo grass, blue grama, sideoats grama, and bluestem.

Osage clay loam is developed principally along the flood plains of Big Sandy, Rock, Buckhorn, Oil, Mill, Colbert, and Chigley Sandy Creeks.

Verdigris clay loam.—Verdigris clay loam is a brown alluvial soil occurring in small creek valleys at elevations of only a few feet above the stream channel. It is made up of Prairie soil materials transported by overflow water and is similar to Osage clay loam, with which it is associated in some places, except for its lighter colored surface soil, probable lower content of organic matter, and more acid reaction. The soil, to a depth of about 12 inches, is brown clay loam or silty clay loam which becomes slightly lighter colored with increase in depth. This grades into slightly lighter brown clay which, below a depth of about 30 inches, passes into a variable subsoil comprising beds of clay, sand, or gravel. Thin layers of black soil material are present in the subsoil in many places.

This is a highly productive soil which produces good yields when the crops are not damaged by overflows. Alfalfa, corn, grass, and pecans are particularly well adapted to this soil. Good yields of cotton are obtained in some seasons, although damage from the boll weevil often is severe during wet seasons. Approximately 75 percent of the soil is cultivated. Of the cultivated land about 45 percent is in corn, 35 percent in cotton, 10 percent in alfalfa, and 10 percent in oats. Corn yields from 10 to 40 bushels an acre, cotton 100 to 300 pounds, oats 15 to 50 bushels, and alfalfa 2½ to 3½ tons.

The total area of this soil is small. The largest bodies are those in the Mill Creek Valley in the east-central part of the county.

Verdigris fine sandy loam.—Verdigris fine sandy loam is a brown alluvial soil composed of sediments deposited by streams draining the light-colored forested upland soils, together with some admixture from Prairie soils. This soil is variable, both in texture and color, but, in general, it is lighter colored than Osage clay loam. The surface soil is brown fine sandy loam, from 6 to 12 inches thick. It grades into brown noncalcareous loam which, below a depth of about 21 inches, passes into brown noncalcareous clay loam.

Most areas of this soil are surrounded by rough land and are not readily accessible; consequently, they are utilized only for pasture. Overflow is frequent. A few small areas are devoted to corn, cotton, and Johnson-grass hay, and yields are slightly higher than those obtained on Yahola very fine sandy loam, a more extensively farmed bottom-land soil.

The principal areas of this soil border Big Sandy and Rock Creeks. Its total area is slightly less than 2 square miles.

Yahola silty clay loam.—Yahola silty clay loam occupies the first bottoms in Washita River Valley. Frequent overflow makes the production of crops uncertain. The soil has a chocolate-brown or red silty clay loam surface soil, about 10 inches thick. This grades into brownish-red or reddish-brown clay or clay loam, which, at a depth of about 18 inches, is underlain by red or brown very fine sandy loam. This material, in turn, passes into red, yellow, or brown fine sand at a depth ranging from 2 to 3 feet. Small areas of a clay soil in old river channels and of a loose sandy soil in old natural river levees are included with the soil in mapping. The upper part of Yahola silty clay loam, as mapped in this county, is noncalcareous in most places, a feature in which it differs from the typical Yahola soil, as mapped in other parts of Oklahoma and Texas, where the surface soil generally is calcareous. The parent soil material in this county, however, is not acid but is basic in reaction.

Johnson grass grows luxuriantly. It is produced both for hay and pasture. There are a very few fields of corn and cotton in the better drained areas, from which the yields are slightly higher than those obtained on Yahola very fine sandy loam. Native pecan trees grow well and yield very good crops of nuts. The protection of this land from overflow by the use of levees is not practical because of the cost of reclaiming such small areas. These low areas lie within wide bends of the Washita River and total only 2.9 square miles.

Yahola very fine sandy loam.—Yahola very fine sandy loam is a sandy bottom-land soil occurring in the flood plain of Washita River. It is a fairly fertile soil, but occasional overflow makes the production of crops rather precarious. The 8-inch surface soil is loose and friable reddish-brown very fine sandy loam or loamy very fine sand. Below this the subsoil is variable. It consists of brown or reddish-brown fine sandy loam, very fine sandy loam, or red silty clay loam, continuing to a depth of about 24 inches, where it passes into coarser and more sandy material of red or yellowish-red fine sand or very fine sand. As in Yahola silty clay loam, the upper part of the soil is noncalcareous, therein differing from typical Yahola soils mapped elsewhere in Oklahoma and Texas, which are calcareous throughout. Most of the parent materials of this soil were derived from the red sandy upland soils of the Red Beds of western Oklahoma and Texas.

Most of this soil is utilized for the production of pecans from native trees and for Johnson-grass hay and pasture. Small areas are devoted to cotton, alfalfa, and corn, of which the yields are variable and generally not very large. Such a small area is cultivated, however, that only rough estimates of yields can be made. These are given as 100 to 200 pounds of lint cotton to the acre, 15 to 30 bushels of corn, 1½ tons of sorgo forage, and 1 to 3 tons of Johnson-grass hay.

The native vegetation consists mainly of trees, chiefly pecan, elm, red oak, boxelder, sycamore, cottonwood, and willow.

Small bodies of this soil are scattered along Washita River, mostly on the insides of wide curves of the river course. Their total area is small.

McLain silty clay loam.—McLain silty clay loam is a dark-brown soil occurring on low terraces along Washita River, which are overflowed occasionally. The surface soil is dark-brown or black silty clay, about 14 inches thick, which is very friable and easily worked. When dry it breaks into soft clods from one-eighth to one-half inch in diameter. When thoroughly dry, the material has a chocolate-brown or brown hue. The surface soil grades into dark-brown or almost black crumbly clay or clay loam. The subsoil, below a depth of 30 inches, is red or brownish-red crumbly clay. This material is calcareous in places, but the layers above, although basic in reaction, are not calcareous. Near the edges of the valley the lower part of the subsoil is brown instead of red. This soil occupies flat areas, and, in places, run-off water from bordering slopes of the adjacent upland areas overflows the land. Most areas are not overflowed from the river water.

This is the most productive soil in the county. Corn yields from 20 to 55 bushels an acre; cotton, 120 to 300 pounds; oats, 20 to 60 bushels; and alfalfa, 2½ to 4 tons. Overflows damage crops on this soil only about once in 10 or 15 years. Practically all of the land is cultivated, and approximately 40 percent of it is in corn, 35 percent in cotton, 15 percent in alfalfa, and 10 percent in oats.

The native vegetation was trees, probably elm, red oak, post oak, pecan, and hickory. Practically all of the trees have been removed, but many native pecan trees remain and produce very well (pl. 1, *B*). Areas of this soil are in the vicinity and north of Davis.

McLain very fine sandy loam.—McLain very fine sandy loam is a dark soil occurring on the low terraces of Washita River. Except for the lighter texture of the surface soil, it is like McLain silty clay loam. The surface soil, to a depth of 8 inches, is dark-brown or faint reddish-brown heavy very loose and friable very fine sandy loam which breaks to a loose crumb structure. This material grades into very dark chocolate-brown crumbly silty clay loam. The material, where exposed, dries and separates naturally into irregular sharp-angled clods from one-fourth to one-half inch in diameter. The clods are dark colored on the outside but lighter colored within, and the material is brown or reddish brown when crushed. Below a depth of 16 inches is chocolate-brown heavy silty clay loam faintly mottled with reddish brown, and this passes, at a depth of 22 inches, into brownish-red silty clay. In exposed cuts this material, when dry, separates into shiny-faced irregular aggregates from one-sixteenth to one-eighth inch in diameter. The material of the profile is noncalcareous above a depth of 36 inches in most places, although it is basic in reaction. Below this depth is red silty clay containing a few white or light-gray particles of lime. In some places, the upper part of the subsoil is grayish brown, and it becomes reddish brown only in the lower part.

Practically all of this soil is in cultivation, and approximately 40 percent is devoted to corn, 35 percent to cotton, 20 percent to alfalfa, and 5 percent to oats. Yields of corn range from 15 to 50 bushels an acre; cotton, 120 to 300 pounds; and alfalfa, 2 to 4 tons. Overflow covers this soil about once in 10 or 15 years. Poor drainage conditions occasionally occur during exceptionally wet seasons and delay the planting of spring crops.

Small areas of this soil are scattered along the Washita River Valley, particularly near Dougherty and north of Davis. This is an inextensive soil.

Teller fine sandy loam.—Teller fine sandy loam is a sandy soil developed on terraces which lie above the level of overflow in the Washita River Valley. The 3-inch surface layer in virgin areas is brown or very dark brown fine sandy loam. The color becomes lighter when the land is placed in cultivation. The surface soil in cultivated areas is brown friable fine sandy loam about 8 inches thick. This grades below into brown heavy fine sandy loam, which becomes slightly red with increase in depth and, at a depth ranging from 14 to 24 inches, passes into yellowish-red very friable sandy clay loam. The material is noncalcareous throughout, although basic or neutral in reaction. A few very small areas are included, which consist of very light colored deep fine sand overlying red sandy clay at a depth ranging from 30 to 50 inches. If they were more extensive, they would be mapped as Teller fine sand.

The native vegetation probably consisted chiefly of post oak, elm, hickory, and Osage-orange, or bois d'arc, trees. Some bluestem and other coarse grasses cover open fields. Most of the land is cleared, and approximately 80 percent is in cultivation, of which about 65 percent is in cotton, 15 percent in corn, 5 percent in alfalfa, and 15 percent in Johnson-grass hay. Yields of crops are somewhat lower than those obtained on most of the other soils on terraces. Corn yields from 10 to 30 bushels an acre; cotton, 80 to 250 pounds; and alfalfa, 1 to 3 tons.

This soil is developed on flat or slightly rolling terraces and is well drained. In places, the terraces are so low that overflows occur about once in 15 years, but most of the land is not overflowed. Fruit trees should do well.

The principal areas are south of Davis and in the vicinity of Dougherty in Washita River Valley. This is not an extensive soil.

Teller very fine sandy loam.—Teller very fine sandy loam is a brown or chocolate-brown soil occurring on the terraces along Washita River. The 10-inch surface soil consists of brown or chocolate-brown friable very fine sandy loam. It grades into brown or yellowish-brown silt loam or very fine sandy loam, which, below a depth of 15 inches, gives way to reddish-brown or yellowish-brown clay loam. At a depth of 34 inches, this material, in turn, grades into yellowish-brown or red clay loam which continues to a depth of many feet. The entire soil is noncalcareous but probably is not acid in reaction.

The areas of this soil are flat but, as a rule, both surface drainage and underdrainage are good. Overflow occurs about once in 10 or 15 years on some of the lower terraces, but most of the land lies above overflow.

Practically all of the land is in cultivation. Approximately 45 percent is cropped to corn, 35 percent to cotton, 10 percent to oats, and 10 percent to alfalfa, of which the yields range from 18 to 50 bushels, 120 to 300 pounds, 20 to 60 bushels, and 1½ to 3½ tons, respectively, an acre. Many of the native pecan trees have been preserved and left in cultivated fields. This is one of the most valuable and easily cultivated soils in the county. Practically all of the native vegetation has been removed. Apparently it was

chiefly post oak, blackjack oak, red oak, ash, chinquapin oak, and a few elm and pecan trees.

Most of this soil is in the Washita River Valley, north and south of Davis, and in the vicinity of Dougherty. A small area lies southeast of Sulphur along Mill Creek.

Brewer clay.—Brewer clay resembles Osage clay loam in color and other features, but it lies on higher terraces than does that soil and, consequently, is not overflowed except rarely in certain low areas. To a depth of 16 inches, the surface soil is very dark grayish-brown or almost black very friable clay. Below this is brown or grayish-brown silty clay which, in places, is so heavy and so dense that it approaches a claypan. The subsoil, below a depth of 3 feet, is gray calcareous clay.

The land is very flat, and crops suffer from poor drainage conditions during wet springs, often having to be replanted when rain follows planting. The soil is very productive, especially for corn, oats, and cotton. Alfalfa does not do well because of restricted drainage. Approximately 75 percent of the land is cultivated, of which about 55 percent is in corn, 30 percent in cotton, 10 percent in oats, and 5 percent in alfalfa. Corn yields from 10 to 40 bushels an acre; cotton, 100 to 300 pounds; and alfalfa, 3 to 3½ tons. Fertilizers are not needed. The flatter areas should be drained by open ditches, in order to provide an outlet for excess water during wet springs. Tile drainage probably would be inadequate because of the heavy subsoil. The native vegetation is largely elm, red oak, pecan, post oak, and blackjack oak.

The soil occupies a number of areas situated mostly in Washita River Valley west of United States Highway No. 77. The total area is 6 square miles.

Brewer silty clay loam.—Brewer silty clay loam is very similar in character to Grayson clay loam but definitely is developed from old alluvium instead of shale and does not have a very mature profile development. The 10-inch surface soil is dark grayish-brown or nearly black rather crumbly silty clay loam which, when dry, is moderately friable and breaks to a loose crumb structure. It grades into dark-gray or almost black silty clay loam which is crumbly when moist. The exposed dry material breaks apart into irregular crumblike aggregates with rough surfaces. This material grades into a fairly distinct gray layer, about 1 inch thick, which consists of streaked and spotted gray and grayish-brown very fine sandy clay loam and is acid in reaction. This rests rather abruptly on brown and yellowish-brown mottled heavy dense clay which is a fairly distinct claypan. At a depth of about 24 inches, small specks and spots of lime are present.

This soil is well suited to the production of oats, corn, and cotton. Yields are practically the same as those obtained on Grayson clay loam. Erosion generally is not very severe, because of the smooth or nearly flat surface. The heavy subsoil is not very favorable to the growth of trees or alfalfa. All the land is in cultivation, and the principal crops grown are oats and corn. Cotton yields from 150 to 300 pounds to the acre; corn, 15 to 40 bushels; and oats, 20 to 50 bushels.

This soil is developed principally in the vicinity of Davis on high old terraces consisting of Washita River Valley alluvium, and its total area is small.

NONARABLE SOILS AND MISCELLANEOUS LAND TYPES

The nonarable soils and miscellaneous types of land are unsuited to the growth of cultivated crops or hay crops because of their broken or stony relief. Included in this group are both forested and prairie land. The forested land is utilized for the production of fence posts and firewood and, to less extent, for grazing. The prairie areas are utilized for pasture, and they constitute most of the land included in large cattle ranches. The most extensive areas of nonarable soils are in the Arbuckle Mountains in the southern and southwestern parts of the county, but there are large areas also in the northern part. This group of soils, which constitutes about one-half the area of the county, includes rough stony land (Denton soil material), Denton stony loam, Brackett gravelly loam, Chigley gravelly loam, rough stony land (Tishomingo soil material), and rough broken land (Gilson soil material).

Rough stony land (Denton soil material).—Rough stony land (Denton soil material) comprises limestone hills and rocky prairies which are too stony or broken for cultivation. The spaces between the stones are filled with dark-brown calcareous fine-earth material which resembles the surface soil of Denton clay loam. Bluestem and other grasses grow luxuriantly in these pockets.

The importance of this land from the point of view of area is considerable, as it covers almost one-third of the total area of the county. Its principal use is for grazing cattle, although it seems that the range could be used also for grazing sheep or goats. Most of the larger areas are held by a few cattle companies, and these areas generally are fenced in blocks ranging in size from 3 to 5 square miles. This allows the rotation of grazing the cattle from one part of the range to another and makes it possible to conserve the range grasses for winter grazing. The carrying capacity of the pasture is approximately 1 cow to each 8 acres, or 80 head to the section. Some of the smoother areas can carry about 90 head to the section. Most of the cattle raised on these extensive pastures are beef cattle of Hereford or Aberdeen Angus breeds.

The principal areas of this land are those in the Arbuckle Mountains south and southwest of Davis. Other important areas are southeast of Sulphur.

Included with this land in mapping are some areas of rough stony land which have developed from a conglomerate limestone. Here the rocks have weathered more deeply, and the fine earth accumulated between the rocks supports, in places, a scattered growth of trees, chiefly chittamwood, persimmon, blackjack oak, blackhaw, red haw, Chickasaw plum, and hackberry.

Denton stony loam.—Denton stony loam is somewhat similar to Denton clay loam, deep phase, but is more shallow and stony than that soil. The 6-inch surface soil is brown friable calcareous clay loam containing numerous hard limestone or dolomitic limestone gravel and stones, which, in many places, are so abundant that the land cannot be cultivated. Below the thin surface soil is broken

limestone or dolomitic limestone and gravel interbedded with calcareous shales. In places, a layer of brown or yellowish-brown marly material lies between the surface soil and the stony subsoil. Where the stones are not so numerous as is typical, this soil is devoted to the production of cotton and sorghums, but most of the land is utilized as pasture. A few trees grow in places where the limestone is a limestone conglomerate.

Denton stony loam is developed principally in the eastern part of the county in the vicinity of Scullin and southward almost to the county line. Its total area is 24.8 square miles. The land is covered with a good growth of bluestem, with some side-oats grama, blue grama, and buffalo grass. The carrying capacity of the pasture is approximately 100 cattle to the square mile.

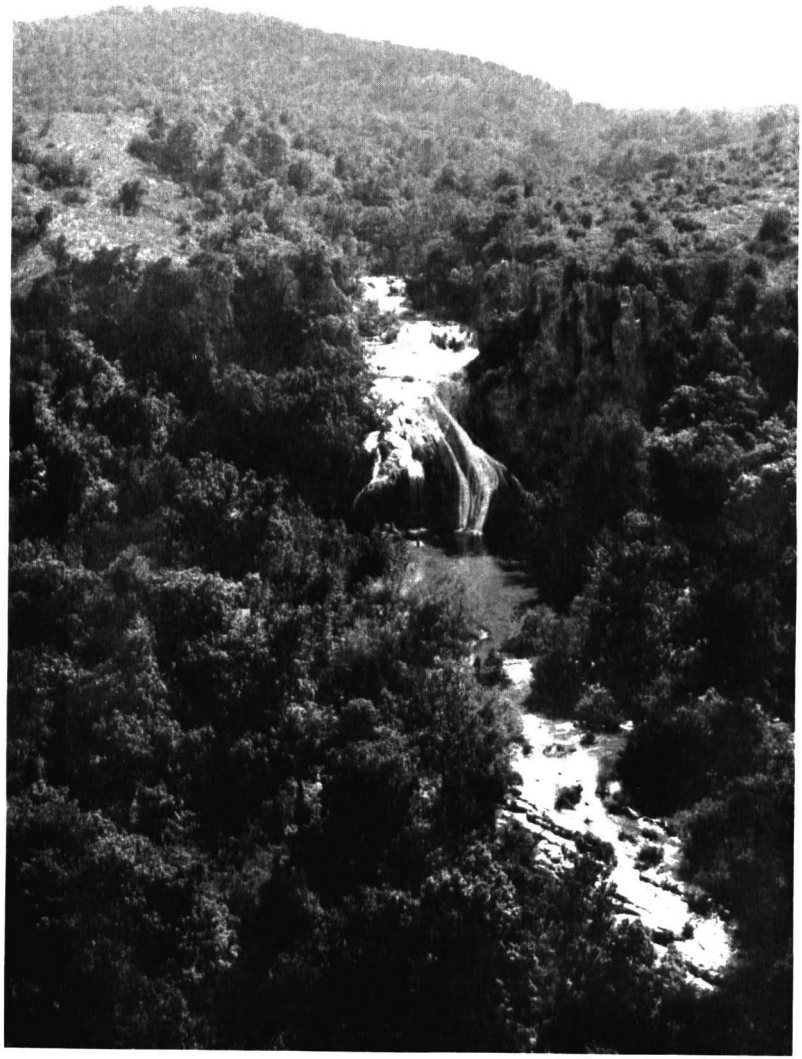
Brackett gravelly loam.—Brackett gravelly loam is a shallow Prairie soil. To a depth of 6 or 8 inches, the surface soil is grayish-brown or almost gray, or chalky, loam or gravelly loam. Below this is grayish-brown and white mottled gravelly loam containing some hard limestone fragments or stones. This material grades into the parent limestone interbedded with calcareous shales. Beneath this are beds of solid or broken limestone. Limestone outcrops in many places. Both surface soil and subsoil are calcareous.

The native vegetation is largely bluestem, with some buffalo, blue grama, and side-oats grama grasses. The land is so steep and gullied that it is unsuited to cultivation. Stony outcrops further impede cultivation, and most of the soil is utilized for pasture. The carrying capacity of the native pasture is approximately 6 acres to the cow.

This soil is associated with Denton clay loam, deep phase, along the breaks or slopes along small stream courses, principally northwest of Sulphur and north of Davis. A few areas occur on hilltops. A few small areas of a red clay soil are included with this soil on the map.

Chigley gravelly loam.—Chigley gravelly loam is similar to Chigley fine sandy loam, but, in most places, it is less red in the subsoil and more gravelly on the surface than that soil. Also, its relief is more sloping or steeply rolling than that of the other Chigley soil. The 3-inch surface layer consists of very dark brown loose gravelly loam. It is underlain, to a depth of 12 inches, by yellowish-brown or reddish-brown less gravelly clay loam which is very sticky when wet. The gravel are largely of quartz with some of feldspar. Below this and continuing to a depth of 20 inches is yellowish-brown clay containing a few reddish-brown spots or mottlings. This material merges with red or reddish-brown and gray mottled clay loam, with the red color predominant, and, at a depth of 30 inches, grades into gray gravelly clay with a few red mottlings, which, in turn, grades into interbedded granitic conglomerate and shale. The conglomerate is largely of quartz and feldspar rounded fragments cemented by calcium carbonate. The gravel in general range from about one-fourth to 1 inch in diameter, and most of them may be termed pebbles. The conglomerate apparently was outwash from granite, which, later, was cemented by calcium carbonate. This soil is very irregular because of its immaturity and development from a rock that is extremely variable. Variations of this soil include many

A, Open forest on Dougherty very fine sandy loam; *B*, cotton and pecans growing on McLain silty clay loam.



Rough stony land (Tishomingo soil material) which is valued largely for its scenic beauty.

spots, most of which are only a few feet wide, that have red or black surface soils. In some places the clay and gravel beds are exposed on the surface.

Chigley gravelly loam is not suited for cultivation because of its sloping relief, high content of gravel, and low productive capacity. It is also poor grazing land. The native vegetation is mostly post oak and blackjack oak, with some bluestem in the more open areas. The carrying capacity of pasture is about 25 or 30 cattle to the square mile. Probably this land would support goats to much better advantage than cattle because goats can browse on the brush, whereas cattle cannot. This land rarely is cultivated, and average yields are very low, even on the smoother areas. Erosion is very severe after the timber is removed.

Fairly large continuous areas of this soil occur in the northern part of the county around Iona, Chigley, and north of Palmer School.

Rough stony land (Tishomingo soil material).—Rough stony land (Tishomingo soil material) is rough broken and hilly land which consists largely of rocky outcrops, stones, and gravel of hard sandstone, quartzite, rhyolite, and granite porphyry (pl. 2). Between the rocks is fairly deep brown or light-brown gravelly fine sandy loam or loam, which supports a fair growth of post oak, blackjack oak, elm, hickory, hackberry, blackhaw, and red haw trees. Grasses do not grow very well on this land, probably because of the forest growth. This is considered very poor grazing land, although it is utilized to some extent for this purpose. The pastures are said to have a carrying capacity of only about 20 or 30 head to the square mile.

The West Timbered Hills and the East Timbered Hills comprise the largest two areas of this type of rough stony land.

Rough broken land (Gilson soil material).—Rough broken land (Gilson soil material) is similar to Gilson gravelly loam but it occurs on steep slopes, on low hills, and in rather deepy dissected areas. The 3-inch surface layer consists of dark-gray gravelly fine sandy loam. It is underlain, to a depth of about 13 inches, by reddish-brown gravelly fine sandy loam, and below this is yellowish-red gravelly clay which continues to a depth of several feet. Angular and flat gravel and pebbles of chert and sandstone make up most of the surface layer. Only about 15 percent of the mass is fine-earth material. This land consists of the weathered material from Franks conglomerate, shaly sandstone, and possibly some Woodford chert. The conglomerate is largely chert and sandstone gravel cemented with lime. There are a few outcrops of solid conglomerate and of cherty sandstone.

Most of this land is covered with a forest of post oak, blackjack oak, elm, and some ash, chittamwood, and hackberry. It is utilized for the scant grazing it affords. The pasture has a carrying capacity of approximately 40 head of cattle to the section. Goats probably would find better forage on this land than do cattle.

Fairly large areas of rough broken land (Gilson soil material) occupy the breaks of Rock and Big Sandy Creeks in the vicinity and north of Dougherty.

PRODUCTIVITY RATINGS

Table 9 lists the soils of Murray County and the average yield of crops on each of these soils.

TABLE 9.—*Estimated average acre yields of principal crops on each soil and land type in Murray County, Okla.*[1]

Soil type	Corn	Cotton	Oats	Sorghum forage	Alfalfa	Wild hay	Pasture
	Bu.	*Pounds*	*Bu.*	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [2]
McLain silty clay loam	23	175	50	3	3	------	50
McLain very fine sandy loam	25	175	45	3	3	------	50
Teller very fine sandy loam	25	175	45	3	3	------	50
Brewer silty clay loam	20	160	40	2½	2½	0.7	60
Summit clay loam	20	160	40	2½	2	.8	70
Grayson clay loam	18	150	40	2½	2	.7	60
Osage clay loam	20	140	35	2½	2½	------	60
Verdigris clay loam	18	140	35	2½	2½	------	60
Brewer clay	15	140	35	2¼	2	.6	55
Teller fine sandy loam	17	120	30	2	1	------	30
Durant very fine sandy loam	17	130	35	2¼	1	.6	55
Denton clay loam, deep phase	15	130	35	2	1	.7	60
Dougherty very fine sandy loam	14	125	25	2	------	------	35
Durant fine sandy loam	15	120	30	2	------	.5	50
Newtonia very fine sandy loam	13	100	27	1½	------	.6	60
Verdigris fine sandy loam	20	100	24	2	1½	------	35
Roff coarse sandy loam	13	100	25	1½	------	.5	50
Yahola silty clay loam	15	80	20	2	1	------	50
Yahola very fine sandy loam	16	80	15	2	1	------	45
Gilson gravelly loam	10	70	10	1	------	------	20
Buckhorn fine sandy loam	12	80	10	1	------	------	15
Conway fine sandy loam	12	80	10	1	------	------	15
Chigley fine sandy loam	8	60	10	1	------	------	15
Dougherty very fine sandy loam, eroded phase	8	70	8	1	------	------	10
Brackett gravelly loam	------	------	------	------	------	------	40
Denton stony loam	------	------	------	------	------	------	50
Chigley gravelly loam	------	------	------	------	------	------	20
Rough stony land (Denton soil material)	------	------	------	------	------	------	40
Rough broken land (Gilson soil material)	------	------	------	------	------	------	10
Rough stony land (Tishomingo soil material)	------	------	------	------	------	------	5

[1] The yields given are for average conditions, and soils which have had poor care in the past will not produce so good an average.

[2] "Cow-acre-days" is a term used to express the carrying capacity of pasture land. As used here, it is the product of the number of animal units carried per acre multiplied by the number of days the animals are grazed without injury to the pasture. For example, a soil type able to support 1 animal unit per acre for 360 days of the year rates 360, whereas another type able to support 1 animal unit per 2 acres for 180 days of the year rates 90. Again, if 4 acres of pasture support 1 animal unit for 100 days the rating is 25.

In table 10 the soils are rated according to their ability to produce the more important crops grown in this county. This rating compares the productivity of each soil for each crop in the county to a standard rating of 100, which is the rating of the soil that is inherently the most productive in the United States for the crop under consideration and occupies sufficient acreage to warrant classing it as the standard soil for that crop. The rating of 100 is called the base index and is the standard with which the productivity of all other soils for any particular crop is compared. Thus, a soil estimated to be one-half as productive of a given crop as the one having the base index rating is given a rating of 50.

TABLE 10.—*Classification of the soils of Murray County, Okla., according to their productivity for various crops*

Soil type	Corn	Cotton	Oats	Sorghum forage	Alfalfa	Wild hay	Pasture
McLain silty clay loam	45	45	100	75	75	----	50
McLain very fine sandy loam	50	45	90	75	75	----	50
Teller very fine sandy loam	50	45	90	75	75	----	50
Brewer silty clay loam	40	40	80	60	60	70	60
Summit clay loam	40	40	80	60	50	80	70
Grayson clay loam	35	40	80	60	50	70	60
Osage clay loam	40	35	70	60	60	----	60
Verdigris clay loam	35	35	70	60	60	----	60
Brewer clay	30	35	70	55	50	60	55
Teller fine sandy loam	35	30	60	50	25	----	30
Durant very fine sandy loam	35	30	70	55	25	60	55
Denton clay loam, deep phase	30	30	70	50	25	70	60
Dougherty very fine sandy loam	30	30	50	50	----	----	35
Durant fine sandy loam	30	30	60	50	----	50	50
Newtonia very fine sandy loam	25	25	55	40	----	60	60
Verdigris fine sandy loam	40	25	50	50	35	----	35
Roff coarse sandy loam	25	25	50	40	55	50	50
Yahola silty clay loam	30	20	40	50	25	----	50
Yahola very fine sandy loam	30	20	30	50	25	----	45
Gilson gravelly loam	20	15	20	25	----	----	20
Buckhorn fine sandy loam	25	20	20	25	----	----	15
Conway fine sandy loam	25	20	20	25	----	----	15
Chigley fine sandy loam	15	15	20	25	----	----	15
Dougherty very fine sandy loam, eroded phase	15	15	15	25	----	----	10
Brackett gravelly loam	----	----	----	----	----	----	40
Denton stony loam	----	----	----	----	----	----	50
Chigley gravelly loam	----	----	----	----	----	----	20
Rough stony land (Denton soil material)	----	----	----	----	----	----	40
Rough broken land (Gilson soil material)	----	----	----	----	----	----	10
Rough stony land (Tishomingo soil material)	----	----	----	----	----	----	5

The productivity indexes are based on the ability of the soil to produce crops without the addition of irrigation water, terracing, drainage, or the use of fertilizers, manure, or lime. The indexes of many of the soils in this county could be raised considerably by the application of fertilizers and irrigation water. The ratings are made on the basis of interviews with farmers, observation of crops on soils, and study of the soil profile. Economic factors are not considered in these ratings, so they cannot be interpreted directly into land values except in a general way. Distance to market, relative prices of farm products, and other factors influence the value of land.

Following is a list of the important crops of the county and the acre yield which has been set up as a standard of 100 for each crop:

Crop:		
Corn (grain)	bushels	50
Oats	do	50
Cotton (lint)	pounds	400
Forage (from sorghums)	tons	4
Alfalfa	do	[1] 4
Wild hay	do	1
Pasture	cow-acre-days	100

[1] Since publication of the Soil Survey of Carter County, Okla., the standard yield used for alfalfa is 4 tons instead of 4½.

RECOMMENDATIONS FOR THE MANAGEMENT OF MURRAY COUNTY SOILS[1]

A diversified system of farming should be used on the majority of the farms in this county. A high percentage of the land is used for

[1] This section of the report was written by H. J. Harper, professor of soils, agronomy department, Oklahoma Agricultural and Mechanical College.

pasture because the soils are shallow or the surface is too stony or too rough for cultivation. Overgrazing has reduced the vigor of desirable grasses, such as little bluestem, and less palatable grasses and weeds have appeared. Restricted grazing is the most important method that must be used in order to improve the carrying capacity of these areas, as much of the land is stony or rough and weeds cannot be controlled by clipping. A combination of sheep and cattle grazing has proved effective in improving the pastures where weeds that sheep will eat are growing. Bur-clover should be introduced into pastures where the soil has developed on limestone or on calcareous material. A nonacid soil, well supplied with available phosphorus, seems to provide a favorable environment for the development of this crop. Lespedeza will make a good growth on cultivated soils, but it does not survive in competition with native grass, except on areas that have been severely overgrazed and a sparse vegetative cover grows. Korean lespedeza will grow on acid soil, but it also will respond favorably to an application of limestone when grown under such conditions.

The most important area of cultivated land in this county is in the Washita River Valley. The soils that have developed in this valley are high in natural fertility, although some of those on the high terraces have suffered severely as a result of soil erosion which has taken place since the land was put into cultivation. There are very few farms that are not adapted to the development of a livestock system of farming; consequently cropping systems which provide forage and feed should be utilized more extensively than systems in which corn, small grain, or cotton is produced. Owing to summer droughts, the production of corn in Oklahoma has been very low for a long time. The use of winter barley in place of corn will provide grazing for livestock in the fall and early spring and also will protect the land from soil erosion. The barley matures before hot weather occurs, whereas corn may be damaged by drought which may occur at time of tasseling or later in the season. Michigan or Oklahoma Winter barley will make a good growth on the dark Prairie soils and on the bottom lands not subject to frequent overflow. This crop is superior to wheat when planted following alfalfa because, usually, it does not grow so tall and is not so subject to lodging. It may be damaged occasionally by infestation of the chinch bug.

Alfalfa can be grown on practically all of the bottom-land soils where internal drainage is satisfactory. As the price of cotton has been comparatively low during the last few years, there has been an increase in the acreage of other crops which provide a larger farm income. Alfalfa is an important crop in the development of a livestock system of farming, as it provides both hay and pasture. It increases the nitrogen content of the soil, which is necessary in order to maintain good yields of corn and small grains. There should be a marked increase in the acreage of alfalfa.

Legume crops, grown in a rotation with a small grain on upland soils, should be used more extensively, in order to maintain the nitrogen content of the soils. Frequently lespedeza and sweetclover

seedlings perish when planted with a nurse crop of small grain; and when they are planted alone, the income from the land is reduced. An extensive test on the effect of planting small grain in widely spaced rows, compared with yields obtained from rows spaced 7 inches apart, indicate that the yields of grain will be approximately the same, considering that less seed is required to plant the widely spaced rows than the narrow-spaced ones. Less competition takes place between the small grain and the legume seedlings when the rows of small grain are 14 inches apart; consequently, the legume seedlings are larger when the small grain is harvested and are, therefore, capable of surviving more extensive periods of drought.

Row-crop farming on sloping land has resulted in considerable loss of surface soil in many parts of this county, and a permanent system of agriculture cannot be developed without introducing close-planted crops on the areas so affected. Continual cultivation of land that is not subject to erosion also has decreased the nitrogen content of many soils. The effect of cultivation on the loss of nitrogen, organic matter, and readily available phosphorus in the soils of this county is shown in table 11.

TABLE 11.—*Losses of plant nutrients in the soils of Murray County, as a result of cultivation*

[Average of 18 comparisons]

Soil condition	Nitrogen	Organic matter	Phosphorus	Readily available phosphorus
	Pounds [1]	*Pounds* [1]	*Pounds* [1]	*Pounds* [1]
Virgin	2,656	63,000	891	24
Cropped	1,718	36,000	936	22
Loss	938	27,000	[2] 45	2

[1] Pounds per acre in soil 6⅔ inches deep. [2] Increase.

Nearly 40 percent of the nitrogen has been lost as a result of cultivation. The samples of virgin soil were collected from areas of pasture land, meadow, or forest, and they were compared with samples of soil collected from fields which are now in cultivation. More than 40 percent of the organic matter has disappeared. Data on phosphorus does not indicate any decrease in total phosphorus. The subsurface layers of some soil profiles are higher in total phosphorus than the surface soils, owing to variations in parent material. This probably explains the increase in phosphorus which occurred in the cultivated soils analyzed.

A study of the acidity of the soils of this county indicates that a comparatively high percentage of the soils do not need lime, in order to grow such crops as alfalfa, sweetclover, barley, bur-clover, and other lime-loving crops. Of a total of 66 samples of soil collected from various parts of the county and tested for acidity, 17 contained some limestone, 24 were neutral in reaction, 11 samples were slightly acid, 6 were slightly + acid, and 8 were medium acid. A good supply of agricultural limestone is available from a quarry located near

Dougherty for those soils which may need an application of limestone to correct soil acidity. The sandy upland soils in general are more acid than the fine-textured upland soils.

A study of the readily available phosphorus in the soils indicates that a deficiency of phosphorus is a more important problem than is soil acidity, so far as crop production is concerned. Only 35 samples of surface soil were analyzed for readily available phosphorus. The results show that 2 samples were very high in readily available phosphorus, 9 were high, 6 were medium, 10 were low, and 8 were very low in this important plant nutrient. Experiments conducted in this general locality indicate that a marked improvement in the growth of sweetclover and other legumes can be obtained when phosphate fertilizers are applied. Legume crops produce a high protein feed for livestock and also increase the nitrogen content of the soil when abundant nodules, produced by a virile strain of legume bacteria, occur on the roots. A rotation in which a legume crop is grown for soil improvement, and the use of phosphate fertilizers where needed, will maintain crop yields on the soils in this county for a long time.

The chemical composition of several typical soil profiles is given in table 12.

TABLE 12.—*Chemical composition of soils in Murray County, Okla.*[1]

LIGHT-COLORED UPLAND SOILS

Soil type and sample No.	Location	Depth	pH	Organic matter	Total nitrogen	Total phosphorus	Readily available phosphorus
		Inches		*Percent*	*Percent*	*Percent*	*Parts per million*
Buckhorn fine sandy loam:							
3672	NE¼NE¼ sec. 23, T. 1 S., R. 3 E.	0 - 6	7.7	4.43	0.126	0.051	32
Chigley fine sandy loam:							
3593	NW¼ sec. 27, T. 2 N., R. 3 E.	0 - ¼	7.9	12.90	.099	.057	26
3594		¼- 2	8.2	3.52	.097	.049	20
3595		2 - 6	7.2	.25	.034	.037	8
3596		6 - 7	6.3	.10	.044	.039	6
3597		7 -22	4.9	1.10	.026	.025	8
3598		22 -27	5.2	.20	.022	.052	8
3599		27 -32	5.4	.07	.022	.017	8
3600		32 -40	5.6	.17	.031	.021	4
Chigley gravelly loam:							
3683	NW¼ sec. 34, T. 2 N., R. 3 E.	0 - 3	8.0	2.88	.099	.037	44
3684		3 -12	4.6	.63	.056	.041	10
3685		12 -20	4.6	1.21	.052	.053	8
3686		20 -30	5.1	1.03	.044	.051	8
3687		30 -35	5.4	.35	.024	.040	4
3688		35 -46	7.3	.25	.020	.050	8
3689		46+	8.0	.43	.032	.057	68
Conway fine sandy loam:							
3699	SE¼ sec. 5, T. 1 S., R. 4 E.	0 - ¼	7.0	11.60	.203	.074	48
3700		¼- 8	6.0	3.25	.114	.048	18
3701		8 -17	6.4	.40	.024	.049	12
3702		17 -21	6.0	.43	.018	.038	14
3703		21 -35	5.8	.63	.038	.046	24
3704		35+	5.8	.43	.027	.052	10
Dougherty very fine sandy loam:							
3656	Center sec. 18, T. 1 N., R. 2 E.	0 -14	6.7	1.79	.104	.045	8
3657		14 -22	6.2	1.39	.118	.025	4
3658		22 -38	5.8	.88	.091	.039	4
3659		38 -50	6.9	.73	.082	.031	4

[1] These analyses were made at the Oklahoma Agricultural and Mechanical College.

TABLE 12.—*Chemical composition of soils in Murray County, Okla.*—Continued

DARK-COLORED UPLAND SOILS

Soil type and sample No.	Location	Depth	pH	Organic matter	Total nitrogen	Total phosphorus	Readily available phosphorus
		Inches		*Percent*	*Percent*	*Percent*	*Parts per million*
Newtonia very fine sandy loam:							
3693	NW¼ sec. 4, T. 1 S., R. 4 E.	0 - 5	7.3	3.99	0.184	0.068	16
3694		5 -11	6.6	2.22	.153	.040	14
3695		11 -32	6.6	1.46	.026	.048	12
3696		32+	8.7	.30	.018	.039	12
Denton clay loam, deep phase:							
3613	NE¼ sec. 29, T. 1 N., R. 2 E.	0 - 5	8.7	4.61	.254	.073	20
3614		5 -12	8.5	4.07	.175	.037	22
3615		12 -18	8.5	2.93	.147	.051	12
3616		18 -30	8.8	1.69	.082	.053	4
3617		30+	9.1	.67	.034	.039	4
Denton clay loam, deep phase:							
3639	SE¼SE¼ sec. 24, T. 1 N., R. 2 E.	0 - 6	7.4	4.04	.196	.039	20
3640		6 -13	6.7	2.22	.116	.054	20
3641		12 -37	6.7	1.28	.161	.055	12
3642		37+	8.7	.45	.026	.062	4
Durant very fine sandy loam:							
3620	NW¼ sec. 16, T. 1 N., R. 4 E.	0 - 8	6.0	3.18	.140	.048	4
3621		8 -11	5.8	2.56	.103	.034	2
3622		11 -16	5.9	2.31	.086	.040	2
3623		16 -28	6.5	1.35	.057	.048	4
3624		28 -38	7.0	1.45	.083	.075	38
3625		38+	8.2	.97	.050	.045	4
Durant fine sandy loam:							
3953	SW¼ sec. 20, T. 1 N., R. 4 E.	[1] 0 - 6	6.0	6.03	.101	.050	14
3954		6 -10	5.8	1.05	.089	.045	10
3955		12 -24	6.0	.79	.066	.037	8
3956		24 -36	6.5	.48	.048	.057	8
Durant fine sandy loam:							
3662	SW¼ sec. 20, T. 1 N., R. 4 E.	0 -11	7.0	2.38	.110	.067	12
3663		11 -22	5.5	1.54	.099	.031	6
3664		22 -27	5.4	1.13	.065	.031	10
3665		27 -38	6.1	.75	.058	.067	4
3666		38 -50	6.1	.25	.038	.032	6
3667		51+	7.3	.32	.043	.026	18
Durant fine sandy loam:							
4326	SW¼ sec. 20, T. 1 N., R. 4 E.	0 -11	7.1	2.27	.123	.066	4
4327		11 -22	5.5	1.34	.069	.059	1
4328		22 -27	5.7	.90	.071	.067	1
4329		27 -39	5.9	.67	.041	.064	0
4330		39 -51	6.3	.21	.032	.073	11
Durant very fine sandy loam:							
3949	NW¼ sec. 16, T. 1 N., R. 4 E.	0 -12	6.5	1.90	.085	.065	10
3950		12 -20	6.0	1.56	.058	.052	12
3951		20 -32	5.7	.70	.037	.053	10
3952		32 -50	6.7	.45	.042	.072	8
Gilson gravelly loam:							
3587	NW¼ sec. 8, T. 1 S., R. 3 E.	0 - 3	8.5	3.79	.132	.079	14
3588		3 -14	6.7	.40	.022	.067	8
3589		14 -34	4.7	.60	.036	.069	20
3590		34+	5.3	.70	.041	.023	14
Gilson gravelly loam:							
4331	SW¼NW¼ sec. 8, T. 1 S., R. 3 E.	0 - 3	8.3	1.85	.091	.045	4
4332		3 -13	7.2	.49	.023	.053	3
4333		13 -33	4.7	.54	.043	.079	4
4334		33 -40	6.0	.31	.041	.048	25
4335		40+	5.3	.33	.037	.072	3
Roff coarse sandy loam:							
3575	NE¼ sec. 4, T. 1 N., R. 3 E.	0 - 6	6.9	2.60	.099	.029	10
3576		6 -16	7.1	2.77	.120	.059	8
3577		16 -32	5.9	.78	.037	.063	8
3578		32 -37	5.7	.65	.026	.037	8
3579		37+	6.0	.63	.040	.048	20
Summit clay loam:							
3628	NE¼ sec. 26, T. 2 S., R. 3 E.	0 -13	7.1	6.27	.264	.049	40
3629		13 -18	7.3	3.64	.160	.060	20
3630		18 -23	7.5	2.79	.118	.053	18
3631		23 -45	8.4	1.13	.050	.051	4
3632		45+	8.4	.55	.036	.059	6

[1] Sample taken from cultivated field.

TABLE 12.—*Chemical composition of soils in Murray County, Okla.*—Continued

ALLUVIAL SOILS

Soil type and sample No.	Location	Depth	pH	Organic matter	Total nitrogen	Total phosphorus	Readily available phosphorus
		Inches		*Percent*	*Percent*	*Percent*	*Parts per million*
Grayson clay loam:							
3667	SW¼ sec. 12, T. 2 S., R. 3 E.	0 - 8	7.0	3.46	0.158	0.047	20
3668		8 -19	6.1	3.08	.132	.051	10
3669		19 -31	6.1	1.33	.070	.028	8
3670		31 -42	6.8	.68	.048	.045	8
3671		42 -67+	7.7	.17	.026	.061	56
Durant fine sandy loam:							
3644	SW¼ sec. 23, T. 2 S., R. 3 E.	0 - 6	7.4	1.79	.078	.058	16
3645		[1] 0 - 6	7.4	1.33	.050	.046	14
3646		6 -17	7.1	1.79	.092	.074	8
3647		17 -36	5.6	.83	.050	.045	4
3648		36 -50	5.9	.65	.057	.044	18
Osage clay loam:							
3605	SW¼ sec. 12, T. 1 N., R. 3 E.	0 - 6	7.5	2.63	.116	.039	38
3606		0 -14	7.3	3.29	.154	.055	48
3607		14 -30	8.1	1.61	.066	.047	38
3608		30 -37	8.7	1.04	.052	.059	50
3609		37 -55	9.0	.62	.040	.059	68
3610		55 -80	8.8	.37	.040	.055	40
McLain silty clay loam:							
3634	SW¼ sec. 30, T. 1 N., R. 2 E.	0 -14	7.0	3.15	.148	.055	80
3635		14 -36	7.1	1.54	.094	.082	60
3636		36 -50	7.3	.78	.061	.074	92
Teller fine sandy loam:							
3580	NW¼ sec. 20, T. 1 S., R. 2 E.	0 - 3	7.9	4.26	.159	.054	18
3581		3 - 8	7.4	.50	.024	.072	10
3582		8 -24	7.4	.45	.024	.041	8
3583		24+	5.8	.50	.054	.054	8
Teller very fine sandy loam:							
3673	NE¼ sec. 18, T. 1 S., R. 2 E.	0 - 8	8.4	1.77	.084	.033	64
3674		8 -15	7.9	.43	.028	.033	10
3675		15 -34	6.6	.55	.047	.039	12
3676		34 -50+	6.4	.53	.046	.052	16
Teller very fine sandy loam:							
4318	SW¼NE¼ sec. 18, T. 1 S., R. 2 E.	0 -12	8.2	.72	.033	.073	17
4319		12 -17	8.0	3.09	.029	.064	3
4320		17 -30	5.8	3.09	.046	.064	9
4321		30 -50	5.5	.26	.026	.052	9
Verdigris fine sandy loam:							
3711	NE¼ sec. 30, T. 1 S., R. 3 E.	0 - 6	7.7	1.51	.060	.053	76
3712		6 -21	7.4	1.01	.055	.065	76
3713		21 -37	4.9	.70	.042	.054	72
McLain silty clay loam:							
4322	NW¼ sec. 32, T. 1 N., R. 2 E.	0 -10	8.4	2.58	.139	.086	25
4323		10 -20	8.6	1.55	.081	.060	37
4324		20 -32	8.7	1.42	.071	.061	26
4325		32+	8.6	1.95	.065	.081	35
McLain silty clay loam:							
3707	NW¼ sec. 32, T. 1 N., R. 2 E.	0 -24	7.6	3.22	.114	.061	44
3708		24 -31	8.2	1.54	.082	.062	64
3709		31 -38	8.1	1.84	.084	.057	52
3710		38 -50	8.4	.60	.036	.058	56
Yahola silty clay loam:							
3677	NW¼ sec. 36, T. 1 N., R. 1 E.	0 -12	8.4	2.24	.081	.061	72
3678		12 -28	8.5	.70	.050	.062	88
3679		28+	8.5	.40	.024	.060	72
Yahola very fine sandy loam:							
3680	NW¼ sec. 36, T. 1 N., R. 1 E.	0 - 8	8.5	2.09	.094	.058	68
3681		8 -36	8.4	1.99	.019	.033	84

[1] Sample marked duplicate.

These samples were obtained from virgin profiles; consequently, the organic matter content is higher than in cultivated land. The nitrogen content of the fine sandy loam soils is much lower than the nitrogen content of the clay loam or clay types. The alluvial soils do not contain so much nitrogen as their color might indicate. This is especially true of the McLain soils. A study of the soil reaction of the different profiles indicates that, in many places, the lower

horizons are much more acid than the surface soil. The subsoils frequently are leached by rainfall, but the surface soils continue to receive an annual application of basic material, as a result of the decomposition of the leaves and stems of plants, which tends to concentrate a good supply of plant nutrients in the surface soil.

The total phosphorus content of these soils is variable, but they contain considerably more than the average Oklahoma soil. The readily available phosphorus shows marked variability between the quantity of phosphorus in the surface soils and that in the subsurface horizons. Soils that contain less than 25 parts per million of available phosphorus are considered deficient in this important nutrient. Subsoils low in available phosphorus are less desirable than subsoils which contain a large quantity of this element. Not all soils that have developed as a result of the weathering of limestone are high in available phosphorus, because the parent material on which these soils have developed may be low in phosphorus. Soils similar to Durant very fine sandy loam and Durant fine sandy loam will show a marked response from phosphorus fertilization.

Any resident of Oklahoma who is interested in the availability of the phosphorus in his soil should collect samples of surface and subsurface soil and send them to the Oklahoma Agricultural and Mechanical College at Stillwater, where tests for readily available phosphorus and acidity will be made without charge. Farmers in Murray County should take advantage of this service, because every landowner or tenant should determine what factors may be responsible for the limitation of crop production on land which he is operating.

MORPHOLOGY AND GENESIS OF SOILS

Murray County lies in the soil region of the southern prairies. This region is subject to an average annual rainfall of about 38 inches and an average annual temperature of 63° F. Most of the soils are dark Prairie soils that probably have developed under prairie types of vegetation, consisting largely of bluestem and bunch grasses, although some short grasses also grow. There are fairly extensive areas of light-colored forested upland soils and of soils of alluvial terraces, which supported a native vegetation of deciduous trees. The most extensive group of soils includes the miscellaneous nonarable soils and land types which are immature shallow or stony A-C soils that have a comparatively thin surface soil (A horizon) and the underlying parent material (C horizon), without an intervening well-developed B horizon. This group includes both forested and prairie soils.

Soils included in the group of arable Prairie soils generally have a dark surface soil, more than 6 inches thick in most places, underlain by a brown or yellowish-brown subsoil which becomes lighter brown with depth and grades into parent material overlying calcareous rocks. These soils are only slightly acid or neutral in reaction. The native vegetation is principally bluestem. The soils in this group are the Denton, Summit, Roff, Grayson, Newtonia, and Durant soils. The organic-matter content of most of them is high.

Soils included in the arable forested upland soil group have a 3- or 4-inch dark surface layer, or A_1 horizon, which is very high in

organic matter in the virgin areas. This is underlain by a yellowish-brown A_2 horizon which is highly acid and leached. In most places, this horizon is coarse textured and light colored, and it grades into a much heavier red, reddish-yellow, or yellow subsoil. The parent material of these soils is not calcareous and is highly siliceous in most of them. The soils included in this group are classified in the Chigley, Gilson, Buckhorn, Conway, and Dougherty series. The native vegetation is largely post oak and blackjack oak. The content of organic matter, nitrogen, and available phosphorus is generally low.

Most of the soils developed from alluvium or composed of recent alluvium in the present flood plain have not reached maturity of development. These soils are variable, and they range in age from very youthful soils subject to overflow to old terrace soils, in which the profile is fairly mature. These soils are members of the Osage, Yahola, Verdigris, Teller, McLain, and Brewer series. The organic-matter content of these soils is moderately high, essential plant nutrients are not deficient, for the most part, and, therefore, the productivity is high.

The nonarable soils and miscellaneous land types occur, for the most part, on rough or stony hills and steep slopes, and they are not suited to cultivation. These soils have developed no distinct profile, with the exception of a shallow surface soil which, in many places, is very stony. They are classified as rough stony land (Denton soil material), rough broken land (Gilson soil material), rough stony land (Tishomingo soil material), Denton stony loam, Brackett gravelly loam, and Chigley gravelly loam.

The characteristics of the soils in this county have been determined to a considerable extent by the kind of parent materials. The arable forested upland soils have developed from granitic conglomerate, cherty limestone conglomerate, cherty sandstone, shale, and sandstone. The principal areas occupied by these rocks and associated soils are in the north-central part of the county near Chigley, Iona, and the head of Big Sandy Creek. Other areas occur southwest of Sulphur. The principal areas of arable Prairie soils lie in the central and eastern parts. These soils have developed from limestone or calcareous sandstone. The most important areas occupied by soils of the alluvial terraces occur in Washita River Valley and in the valley of Big Sandy Creek, Chigley Sandy Creek, Rock Creek, and Buckhorn Creek. The nonarable soils and miscellaneous land types, which are developed from various kinds of rock, occur largely in the southwestern third, in the Arbuckle Mountains.

Denton clay loam, deep phase, is the normal Prairie soil of the county. It is developed from limestone interbedded with calcareous shale. A typical profile is as follows:

1. 0 to 6 inches, dark-brown clay loam which in places exhibits a faint prismatic structure when dry. This horizon is very friable and readily breaks into small irregularly rounded or spherical aggregates from one-fiftieth to one-eighth inch in diameter. A few quartz gravel are present in this horizon. According to field determinations, the reaction is neutral.
2. 6 to 13 inches, brown sticky clay loam which breaks down into angular and flat irregular aggregates with shiny surfaces. There is no indication of a prismatic structure. The aggregates or fine clods range

from one-fourth to one-half inch in diameter. There are a few quartz gravel in this horizon. The material is slightly acid.

3. 13 to 37 inches, brown or yellowish-brown heavy clay only slightly lighter colored than the material of the above horizon. It breaks into irregular or cubical clods ranging from one-fourth to three-fourths inch in diameter. The reaction is neutral.
4. 37 to 60 inches, yellowish-brown and gray mottled highly calcareous clay containing some quartz gravel. No cleavage lines are evident. This material is friable. The reaction is neutral.

In gently rolling or rolling areas, the native vegetation on this soil is largely bluestem, with some side-oats grama, black grama, blue grama, and buffalo grass. These grasses make a heavy sod under natural conditions.

Associated with Denton clay loam, deep phase, and occurring on smooth or almost flat divides are a few areas of darker soil which have been classified as Summit clay loam. This soil probably was more extensive in this section at one time, but erosion has mutilated some of it and produced the Denton profile. Another soil associated with Denton clay loam, deep phase, and which occurs on steep slopes and is very immature, is mapped as Brackett gravelly loam. The surface soil is gray or grayish brown, and the parent limestone or partly weathered limestone outcrops in many places. Another immature soil associated with Denton clay loam, deep phase, and which has comparatively smooth relief, is classified as Denton stony loam. This soil is calcareous throughout, as is Brackett gravelly loam, but it has a brown instead of a gray or grayish-brown surface soil. Areas of a red Prairie soil in the eastern part of the county are developed from dolomitic limestone and are designated Newtonia very fine sandy loam. This soil has a chocolate-brown surface soil, a red to reddish-brown subsoil, and rests on solid rock at a depth of about 3 feet. A minor soil in the group of arable Prairie soils is developed from Caney shale and is classed as Grayson clay loam. It has a claypan and an indefinite gray layer. A minor Prairie soil, developed from granitic conglomerate, is Roff coarse sandy loam which is a gravelly soil with essentially the same profile as that of the Denton soils, with the exception of its large content of quartz and feldspar.

Prairie soils developed from calcareous sandstone are classified in the Durant series. A typical profile of Durant fine sandy loam shows the following layers:

1. 0 to 11 inches, dark-brown loose friable fine sandy loam which is much lighter colored when crushed. No definite cleavage planes are evident, but the material breaks into small aggregates one-fiftieth to one-eighth inch in diameter. These aggregates are irregular or spherical in shape. Small ironstone or ferruginous sandstone fragments are scattered over the surface. The reaction is neutral, according to field determinations.
2. 11 to 22 inches, dark-brown fine sandy loam or loam which is more compact than the material of the above horizon. On drying, it breaks into large irregular-shaped five- or six-sided prisms which range from 5 to 10 inches in diameter. The material is much lighter colored when crushed and becomes slightly lighter colored with increase in depth. A few ironstone fragments and small chert gravel are present. According to field determinations, the reaction is neutral.
3. 22 to 27 inches, brown or dark-brown loam or clay loam, which is much lighter colored when crushed and, on drying, breaks into smaller prisms ranging from 3 to 6 inches in diameter. The outside of the prisms is slightly darker than the interior. The reaction is strongly acid.
4. 27 to 38 inches, yellowish-brown and reddish-brown mottled clay loam or fine sandy clay loam, containing numerous black concretions. There is a

very faint indication of prismatic structure, with darker material on surfaces of the prisms. The reaction, like that in the above layer, is strongly acid.

5. 38 to 50 inches, gray and rusty-brown mottled clay loam, in which there are numerous white gravel of fine-grained sandstone, black spots, and concretions probably of iron and manganese oxides. This material is very strongly acid and grades into calcareous sandstone at a depth ranging from 8 to 10 feet.

A mature forested soil is represented in this county by Gilson gravelly loam. This soil is developed from a chert and sandstone conglomerate cemented by lime. A typical profile is described as follows:

1. 0 to 3 inches, very dark grayish-brown or almost black fine sandy loam or gravelly fine sandy loam. The gravel, which are subangular and flat, consist largely of chert, together with some fine-grained sandstone. The reaction is neutral, according to field determinations.
2. 3 to 14 inches, light-brown or yellowish-brown friable gravelly fine sandy loam which shows no definite cleavage planes. The gravel are similar to but are more numerous than those in the layer above. The reaction is very strongly acid.
3. 14 to 34 inches, yellowish-red gravelly clay loam which is sticky when wet. The gravel are similar to those in the surface horizon. The material is very strongly acid.
4. 34 to 60 inches, reddish-brown and yellowish-brown mottled or spotted gravelly loam containing gravel similar to those in the surface soil. The material is very strongly acid. The parent rock of massive conglomerate lies at considerable depth beneath this soil.

The native vegetation consists largely of post oak and blackjack oak, with some hickory, hawthorn, elm, ash, and chittamwood.

Conway fine sandy loam is an example of a light-colored forested soil with a yellow sandy clay subsoil. The relief is almost flat. The soil is developed from noncalcareous sandstone. Drainage of the subsoil appears to be somewhat restricted. A description of a typical profile of this soil follows:

1. 0 to ¼ inch, brown or grayish-brown partly decomposed oak leaves, together with some fine sand. The material is noncalcareous and slightly acid.
2. One-fourth inch to 8 inches, dark grayish-brown loose friable fine sandy loam which is almost black when moist. Field determinations indicate that the material is strongly acid.
3. 8 to 17 inches, grayish-brown or yellowish-brown fine sand with a single-grain structure. This material is strongly acid.
4. 17 to 21 inches, light grayish-brown fine sand which is almost white when dry. As in the overlying layer, the reaction is very strongly acid.
5. 21 to 35 inches, yellowish-brown friable fine sandy clay loam which becomes lighter colored with depth. The material is medium acid.
6. 35 to 50 inches, yellowish-brown and reddish-brown mottled, with the yellowish-brown color predominating, fine sandy clay loam. The reaction is very strongly acid.

SUMMARY

Murray County, situated in south-central Oklahoma, includes an area of 424 square miles, or 271,360 acres. The relief, in general, is rolling or steeply rolling, but some areas are hilly or mountainous. The Arbuckle Mountains, which occupy the southern half of the county, consist of a high hilly stony ridge with a fairly smooth broad crest. In places the ridge is deeply dissected by narrow valleys. The central, northwestern, and northeastern parts of the county are smoothly rolling. The north-central part has rather strong relief, and the broad comparatively flat valley of Washita River runs through

the west-central part from northwest to southeast. This river and its tributaries control the drainage of the county which is well dissected and thoroughly drained.

Before the land was put in cultivation the greater part of the county was covered by a heavy growth of prairie grasses, largely bluestem, other tall bunch grasses, and some side-oats grama, blue grama, and buffalo grass. The north-central and south-central parts supported a forest, in which post oak and blackjack oak were the principal trees. This native growth remains in places where the land has never been placed in cultivation.

Most of the geological material underlying the soils is limestone or limestone conglomerate, but there is some sandstone and calcareous conglomerate.

The climate is temperate and humid. The average annual rainfall at Sulphur is 37.77 inches; the mean annual temperature, 62.7° F.; and the average frost-free season, 219 days.

The land now included in Murray County was a part of the territory belonging to the Chickasaw Nation of Indians, who first settled it. White people gained a foothold after Oklahoma become a State (1907). The agriculture is diversified, but cotton and corn predominate over other crops. Oats, grain sorghums, hay, peanuts, and wheat are crops of less importance. Cattle raising is one of the most important agricultural enterprises.

The soils are classed in four distinct groups, which, together with the approximate percentage of the total area each covers, are, as follows: (1) Arable Prairie soils, 27 percent; (2) arable forested upland soils, 8.2 percent; (3) alluvial soils and soils of old stream terraces, 15.1 percent; and (4) nonarable soils and miscellaneous land types, 49.7 percent.

The arable Prairie soils have brown, dark-brown, or black friable surface soils with lighter colored brown, red, or gray slightly heavier subsoils. Their reaction is slightly acid or neutral. This group comprises soils of the Denton, Durant, Newtonia, Roff, Grayson, and Summit series. With the exception of Newtonia very fine sandy loam, these soils are largely in cultivation. The Newtonia soil occurs in areas so intimately associated with areas of stony soils that the fields are too small for practical cultivation. The chief crops grown on these soils are corn, cotton, oats, and grain sorghums. Yields were large when the land was first cultivated, according to local reports, but, with continued use of the land, yields have declined considerably. Erosion has been responsible for much of the decreased productivity. Average yields of corn in representative fields are said to be about 16 bushels an acre; cotton, 135 pounds of lint; and oats, 18 bushels.

Under virgin conditions the arable forested upland soils have 3- or 4-inch light-brown, gray, or dark-brown surface layers underlain by lighter colored leached layers which, in turn, are underlain by reddish-brown, gray, or yellow clay or clay loam subsoils. The subsoils are, as a rule, much heavier than the surface soils. Under cultivation, the color of the surface soils becomes much lighter. The soils of this group are members of the Chigley, Gilson, Buckhorn, Conway, and Dougherty series. Cotton is the chief crop, although some grain sorghums, oats, and peanuts are grown. Yields

are rather low, as a rule. The productivity of these soils may be built up to considerable extent by proper cultural practices and fertilization. Farmers report beneficial results from the growing and turning under of green-manure crops and from additions of lime and phosphatic fertilizers. All these soils are strongly acid.

The most productive soils are those included in the group of alluvial soils and soils of old stream terraces. They occur in the valleys of Washita River and its tributaries. The soils included in this group are those of the Osage, Verdigris, Yahola, McLain, Brewer, and Teller series. The soils of the first three series are first-bottom soils which often are overflowed. Abundant yields of various farm crops are said to have been obtained on these soils in early days of agricultural use and, although they have declined considerably, yields are still large. Corn is the principal crop, but cotton also is grown extensively. Average yields of corn are given by farmers as about 25 bushels an acre; cotton, 250 pounds; oats, 25 bushels; and alfalfa, 3 tons.

About one-half the land area of the county is occupied by lands so shallow or rough or stony that cultivation is not possible. Most of this land is utilized for the grazing of livestock, mainly beef cattle.

U. S. GOVERNMENT PRINTING OFFICE: 1939

This soil survey is a contribution from

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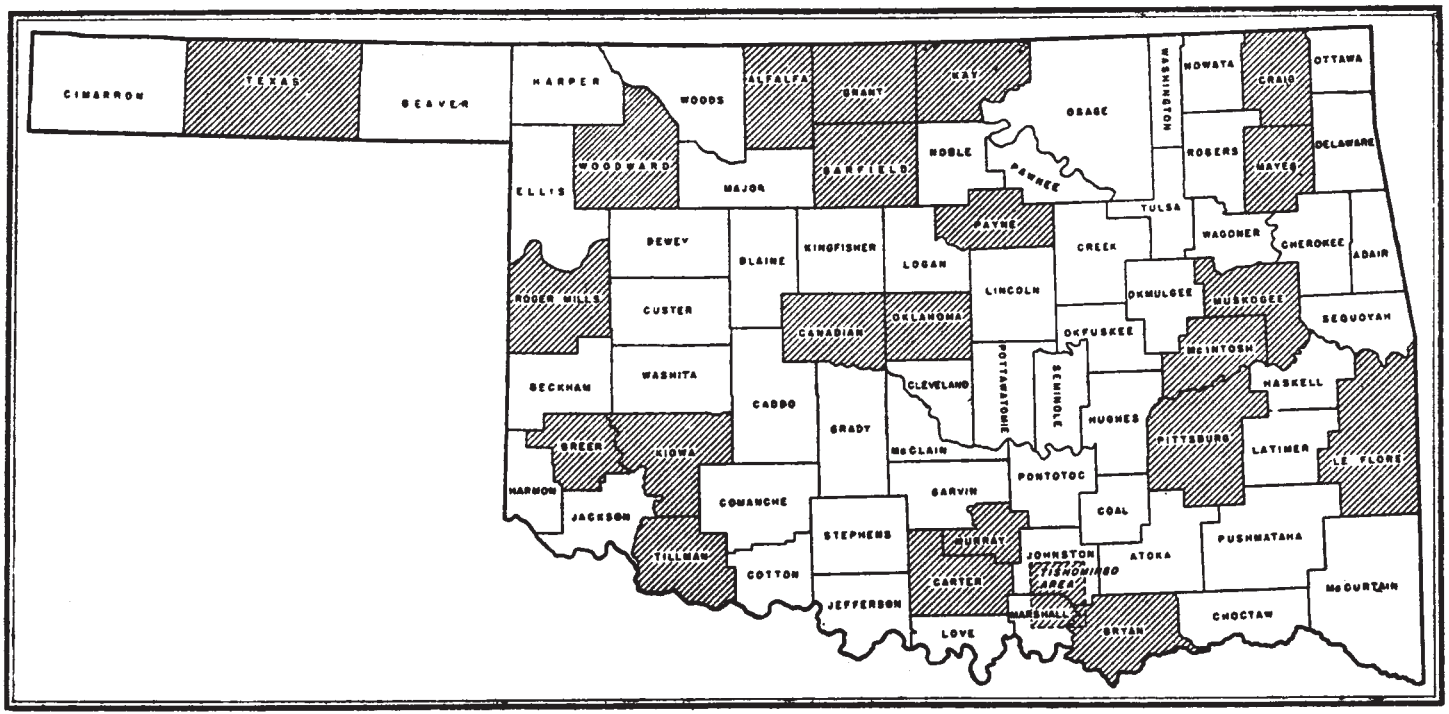

Areas surveyed in Oklahoma shown by shading. Detailed surveys shown by northeast-southwest hatching

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To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by:

(1) mail: U.S. Department of Agriculture
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or

(3) email: program.intake@usda.gov.

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