U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS—MILTON WHITNEY, Chief.

SOIL SURVEY OF PAYNE COUNTY, OKLAHOMA.

BY

W. B. COBB, IN CHARGE, AND H. W. HAWKER.

HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1916.]

WASHINGTON:
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1918.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Soils,
Washington, D. C., March 2, 1918.

Sir: I have the honor to transmit herewith the manuscript report and map covering the survey of Payne County, Okla., and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils for 1916, as authorized by law.

Respectfully,

Milton Whitney,
Chief of Bureau.

Hon. D. F. Houston,
Secretary of Agriculture.

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SOIL SURVEY OF PAYNE COUNTY, OKLAHOMA.

By W. B. COBB, In Charge, and H. W. HAWKER.—Area Inspected by HUGH H. BENNETT.

DESCRIPTION OF THE AREA.

Payne County is situated in the north-central part of Oklahoma. It is bounded on the north by Noble and Pawnee Counties, on the east by Creek County, on the south by Lincoln and Logan Counties, and on the west by Logan County. Its extreme length, east and west, is about 42 miles, and its maximum width 21 miles. Its total area is 695 square miles, or 444,800 acres.

The boundary between the prairies and the plains in the United States is a zone, rather than a line. Payne County seems to lie within this transition belt, its soils and vegetation indicating that it is more nearly related to the former than to the latter. The greater part of it is treeless, but the more broken areas of sandy soil are forested, and there is usually a forested belt along the streams.

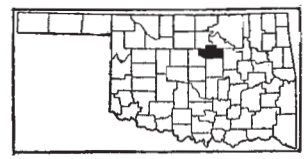


FIG. 1.—Sketch map showing location of the Payne County area, Oklahoma.

The uplands in general are undulating, although there are comparatively large areas of rolling land in the western and extreme eastern parts of the county, and smaller nearly level areas in places, chiefly in the central part. In the western and extreme eastern parts of the county the streams have carvd comparatively deep velleys, bornered by rather step slopes, with exposures of sandstone and shale in places. In the central part the uplands are generally undulating and the slopes to the streams are gradual. The more nearly level areas occur principally about 5 miles south of Stillwater, to the north of this place, in the vicinity of Yost Lake, and east of Glencoe. Other smaller flat areas occur scattered over the county. With the exception of the steeper slopes and the stony areas all the upland is well suited to the use of farm machinery.

The high terrace or second-bottom lands along the Cimarron River are frequently separated from the first bottoms by a belt of gradually sloping or gently rolling land consisting of a former terrace now thoroughly eroded, but on the south side of the river and in a few places along the creeks the terrace areas are directly adjacent to the first bottoms. The flood plain or first bottom along the Cimarron River varies in width from one-fourth mile to nearly 2 miles. The bottom-land developments along the other streams range in width from very

narrow strips along the smaller branches to areas one-half mile wide along some of the larger streams. The terrace and bottom lands are practically everywhere smooth and adapted to farming.

The county ranges in elevation from about 800 to 1,150 feet above sea level. The highest points are the Twin Mounds, about 4 miles west of Yale. The average elevation of the eastern part of the county is somewhat less than that of the western end, which lies from 1,000 to 1,100 feet above sea level. The greater part of the western third slopes southeast toward the Cimarron River, and a smaller part slopes northeast toward Stillwater Creek. The general elevation of the central part of the county is between 900 and 1,000 feet above sea level. The lowest elevations in the county occur along the Cimarron River between Cushing and Yale.

The county as a whole is well drained, practically every section being traversed by a water course or drained by a perceptible slope toward some small stream. In the nearly level areas in the central part of the county, however, and in some bottom-land areas the drainage is not well established, and at certain seasons of the year is poor.

Almost the entire county is drained through the Cimarron River, which empties into the Arkansas River in southeastern Pawnee County. A small area in the northern part is drained northward by Long Branch Creek into Black Bear Creek, a tributary of the Arkansas. The principal tributary of the Cimarron River within Payne County is Stillwater Creek, which drains the northwestern and north-central parts and joins the Cimarron River near Ripley. All the streams except the Cimarron River and lower Stillwater, Council, and Euchee Creeks are practically dry the greater part of the year, and even in wet seasons they seldom overflow their banks.

Payne County was originally part of the Creek Nation and the Cherokee Outlet. The first permanent settlement took place in 1889, when the southern part of the county was opened for homesteading. The part included in the Cherokee Outlet was opened for settlement in 1893. The early settlers came largely from Kansas, Missouri, Arkansas, Texas, and Iowa. In 1890 Payne County had a population of 7,215. By 1900 this had increased to 20,909. In 1910 the population was 23,735. All the population except that in the town of Stillwater is classed as rural. It averages 30 persons to the square mile. Native whites constitute 91.1 per cent of the population, foreign-born whites 2.5 per cent, and Negroes 6.1 per cent. The percentage of Indians in the county is very small.

Since the 1910 census was taken the discovery of oil in the Cushing field has caused a considerable increase in the population of the eastern part of the county. The population of Cushing in 1910 was 1,072. Its present population is estimated at 5,000. The 1910 census

reported the population of Yale as 685. It is now estimated to have between two and three thousand inhabitants. Stillwater, with a population in 1910 of 3,444, is the county seat. The population of Perkins in 1910 was 603, Ripley 368, and Glencoe 373. Smaller towns include Mehan, Ingalls, Quay, Norfolk, Post, Marena, and Clayton. Coyle, Orlando, and Mulhall, in Logan County, serve as market points for near-by farming communities in Payne County.

Good schools are maintained throughout the rural districts. Two or three consolidated schools have been established, and the larger towns have good high schools. The Oklahoma Agricultural and Mechanical College is situated at Stillwater.

No part of the county is more than 8 or 9 miles from a railroad shipping point. The eastern Oklahoma branch of the Atchison, Topeka & Santa Fe Railway extends eastward along the Cimarron Valley to Ripley, and thence up the Stillwater Valley to Stillwater and northeast to Glencoe and beyond. The Cushing branch extends south from Quay through Yale, Norfolk, and Cushing. A connecting line runs from Cushing to Ripley. The Missouri, Kansas & Texas Railway passes through the eastern part of the county, paralleling the Cushing branch of the Atchison, Topeka & Santa Fe. A new railroad connects Cushing with Drumright, an important oil town a short distance over the eastern county line in Creek County. A main line of the Atchison, Topeka & Santa Fe passes just west of the county line, within reach of farmers in Clear Creek and Clarkson Townships.

The public roads are usually in fair condition, except in some of the more broken areas in the extreme western and eastern parts of the county. Considerable road-improvement work is in progress, and a system of good highways between all the towns of the county and the more important near-by towns outside the county is planned. Wherever possible the roads follow section lines. Rural mail-delivery service and telephone lines reach all parts of the county.

Considerable oil is produced in the vicinity of Yale and Cushing, and a number of very productive gas wells supply fuel, and to a lesser extent light, to the larger towns of Stillwater, Cushing, and Yale. In some parts of the county farmers have access to this product.

Oklahoma City and Kansas City are the principal outside markets for live stock and other farm products.

CLIMATE.

The climate of Payne County is mild and generally agreeable, but during the summer months the days are sometimes extremely hot for periods of a week or more, and occasionally during the winter sud-

den changes of temperature caused by "northers" make the climate temporarily disagreeable. The mean annual temperature is about 59° F. Temperatures of 105° to 108° F. frequently occur during the months of July and August, and temperatures of 100° F. have been recorded in all the months from April to September, inclusive. The high temperatures are occasionally accompanied by hot winds, which damage crops. The mean temperature of the winter months is 37.8° F. The highest winter temperature on record is 90° and the lowest −18°, both of which occurred in the month of February. Occasional light snows fall in the winter, but snow does not stay on the ground for any length of time.

The average date of the last killing frost in the spring is April 8, and that of the first in the fall, October 26. The normal growing season is thus nearly 200 days in length, and ample for the maturing of all the common crops. The earliest recorded killing frost in the fall occurred on September 25, and the latest in the spring on May 1.

The average annual rainfall is nearly 34 inches. The total precipitation in the driest year on record (1914) was 16.79 inches, and in the wettest year (1908) 61.1 inches. The greater part of the rainfall comes during the late spring, the summer, and the early fall. In years in which the precipitation is favorably distributed it is ample, but there is frequently a concentration of rainfall followed by long periods of drought, during which crops suffer.

The following table gives the normal and extreme monthly, seasonal, and annual temperature and precipitation as recorded by the Weather Bureau station at Stillwater:

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

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1914).	Total amount for the wettest year (1908).
	°F.	°F.	°F.	Inches.	Inches.	Inches.
December	38.8	74	−2	1.14	1.34	0.03
January	37.1	78	−10	1.19	T	1.23
February	37.4	90	−18	1.08	.65	5.00
Winter	37.8	90	−18	3.41	1.99	6.26
March	50.7	98	0	2.42	1.41	2.36
April	59.2	100	20	3.49	2.25	6.90
May	67.2	100	29	6.05	2.04	11.21
Spring	59.0	100	0	11.96	5.70	20.47

Normal monthly, seasonal, and annual temperature and precipitation at Stillwater—Continued.

Month	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1914).	Total amount for the wettest year (1908).
	°F	°F	°F	*Inches.*	*Inches.*	*Inches.*
June	75.8	105	44	3.69	.51	7.28
July	79.9	108	51	3.16	.52	2.31
August	80.5	108	43	3.41	2.48	2.72
Summer	78.7	108	43	10.26	3.51	12.31
September	73.1	104	36	3.24	3.84	6.11
October	60.9	99	21	2.82	1.23	10.19
November	48.7	88	7	2.14	.52	5.76
Fall	60.9	104	7	8.20	5.59	22.06
Year	59.1	108	−18	33.83	16.79	61.10

AGRICULTURE.

The production of hay from the prairie grasses and the grazing of live stock were the principal industries of the early farmers in this territory. Corn was the leading crop. It was grown largely for food and for the feeding of stock for market. In 1899 corn considerably outranked the hay crop in total acreage. By this time wheat had become an important crop, second to corn in acreage. Hay ranked third but was closely followed by cotton, which was grown on 18,139 acres. Coarse forage was fifth in acreage, and oats sixth, with 5,945 acres.

In 1909 corn was by far the most important crop, occupying 94,391 acres, producing 1,853,844 bushels. Cotton was grown on 48,934 acres, with a production of 18,367 bales. Hay crops occupied 23,870 acres, the production amounting to 25,231 tons. Kafir had become an important crop, being grown on 13,578 acres, producing 197,564 bushels. The fifth crop was oats, which occupied 11,277 acres and gave a production of 331,371 bushels. Only 1,668 acres were devoted to wheat in 1909. Of the hay crops, alfalfa occupied 2,034 acres, millet 3,789 acres, and wild grasses 16,219 acres. In addition, coarse forage was grown on 3,890 acres and yielded an average of almost 2 tons per acre. Sorghum was grown on 448 acres.

Since 1909 the acreage of corn and cotton has been considerably reduced. Owing to their superior drought-resisting qualities, kafir and other grain sorghums have largely taken the place of corn on

the upland soils, and their present total acreage may slightly exceed that devoted to corn. The growing of forage crops, especially alfalfa, has considerably increased, and the acreage devoted to both oats and wheat is much larger than in 1909. Much of the bottom land formerly used for cotton has been devoted to alfalfa. Prairie grass is still the most extensive source of hay and pasturage, but it is not much in advance of other forage crops. Sorghum is grown to some extent for hay. Sudan grass is successfully grown on a number of farms and in some cases is taking the place of sorghum. Peanuts and watermelons are grown on a small scale on some farms. Irish potatoes, sweet potatoes, and other vegetables are grown for home use on nearly every farm, and a small quantity is sold on the local markets. One farm west of Stillwater is equipped with an overhead irrigation system, which is used in the production of vegetables for the local market.

The principal fruit crops of Payne County are apples, grapes, and peaches. The census reports 167,769 apple trees, 70,159 grapevines, and 87,116 peach trees in the county. Pears, plums, and cherries are produced in a small way on some farms. There was a total of 30 acres in strawberries in 1909, producing 48,987 quarts, and 127 acres in blackberries, producing 131,824 quarts.

The value of all crops produced in 1909 amounted to $2,926,238. Cereals amounted in value to $1,182,422, hay and forage to $197,908, vegetables to $86,674, fruits and nuts to $80,727, and cotton and miscellaneous crops combined to $1,375,970. The value of live stock sold or slaughtered amounted to $889,724. Dairy products to the value of $182,155 were produced, exclusive of those used in the home, and $249,011 worth of poultry and eggs were produced.

The census reports 3,121 calves, 9,603 other cattle, and 30,195 hogs sold or slaughtered in 1909. Live stock is kept to some extent on practically every farm. The value of all domestic animals in the county in 1910 is reported as $2,442,901. There were 25,989 head of cattle in the county in that year, of which 11,417 were dairy cows, also 14,014 horses, 3,538 mules, 28,905 hogs, and 1,414 sheep.

A number of farmers who raise live stock buy steers and pasture them on the prairie grass, in some cases feeding alfalfa or sorghum hay and corn or kafir silage in the winter. The animals are generally sold in Oklahoma City or Kansas City. Some farms near the larger towns are devoted largely to dairying to supply milk for local consumption. The Oklahoma Agricultural and Mechanical College at Stillwater conducts a creamery and buys cream from farmers in the neighborhood. The beef cattle are generally grade Herefords and Shorthorns. Jerseys are most commonly used for dairying. Nearly all the farmers raise a few hogs, but only a few specialize in hog raising, and many farmers do not raise enough to

supply the home with meat. Hogs are sometimes kept on alfalfa pasture the greater part of the summer and fattened on corn and kafir in the fall. Peanuts are sometimes used for fattening hogs. Duroc Jersey and Poland China are the most common breeds of hogs. Horses and mules are raised on a number of farms.

The prevailing type of agriculture throughout the county is general farming. The raising of live stock, chiefly cattle, is not as well developed on the bottom lands and terraces as on the upland. On the bottom lands and terraces the farming consists chiefly of the production of corn, cotton, alfalfa, and some oats, kafir, and wheat for sale. Corn, kafir, and oats are used in some measure for feeding work stock and to a smaller extent as roughage for cattle and hogs. In some cases hogs, horses, and mules are pastured on alfalfa during part of the year. Nearly all of the bottom and terrace land is under cultivation, and in general the alluvial soils are the most highly improved. Much of the upland is well developed, especially in the central two-thirds of the county. The uncultivated prairie areas are used as native-hay and pasture land, and the forested areas also are used for pasture. Live-stock raising is confined chiefly to the rougher lands in the western and eastern parts of the county, where the soils are less well adapted to the production of crops.

The natural crop adaptation of the different soils is followed to some extent. The farmers recognize that kafir does better on the upland soils than corn; that alfalfa, cotton, and corn do better on the bottom-land soils than on the upland; and that wheat generally yields best on a fairly heavy soil.

Corn land is generally prepared with a disk harrow or double-row lister. The crop is ordinarily planted about the 1st of April. The seed is drilled in rows 38 to 40 inches apart, the stalks being spaced 15 to 20 inches apart in the row. Cultivation is begun soon after the corn is up, and is usually done with a harrow or a four-shovel cultivator. The general practice is to cultivate after each rain. Early harvesting generally takes place the first part of August. Most farmers husk the corn by hand from the standing stalks, which are afterwards pastured. The most popular varieties of corn are the White Wonder, Yellow Dent, and Boone County White.

For kafir and other grain-sorghum crops, principally milo, feterita, and darso, the land is generally broken in the spring, and disked or listed. Seeding is usually done about the middle of May. The seed is planted in much the same way as corn. The crop is usually cultivated four times to a depth of 4 to 6 inches, and is laid by with a cultivation 2 inches deep. Best results are obtained when the crop is cultivated after each rain. Kafir is harvested about September 15, in

much the same manner as corn. Part of the crop is thrashed, and the grain and fodder are fed to work stock, cattle, and hogs. On a few farms the sorghum crops are used as silage, for which use they compare favorably with corn.

Land for oats is prepared by plowing, disking, and harrowing, in the late winter or early spring. Seeding is done at the rate of 2½ bushels per acre. The crop is seeded as early as possible in the spring, since early sowed oats are less apt to suffer from the ravages of the green bug. The crop is usually seeded about the 1st of March and harvested about the 25th of June. In some cases late-sowed oats are damaged to such an extent by the green bug that it is more profitable to cut the crop green for hay. The variety of oats most commonly grown is the Texas Red.

The seed bed is prepared for cotton by shallow plowing and harrowing, usually in the spring. The seed is planted at the rate of 14 to 17 pounds per acre, in rows usually 42 inches apart, either in flat open furrows or on beds. The plants are thinned to stand from 16 to 20 inches apart. The crop is cultivated ordinarily about 8 times, with small shovels and 8-inch sweeps. The early cultivations are 4 or 5 inches deep and the later ones about 3 inches. Picking is generally begun early in September. The crop is sold in the seed at local gins. Early and late Mebane, Rowden, Sugar Leaf, and Prolific are the principal varieties grown.

Much of the wheat land is plowed in August, but a number of farmers prepare the land just before seeding. When wheat follows a cultivated crop the seed-bed preparation frequently consists of disking shortly before the seed is drilled. The seed is usually put in about October 1, at the rate of 1¼ bushels per acre. The crop is frequently pastured through the winter. Wheat generally matures the second week in June. Cutting is usually done with four-horse binders, and the crop may be thrashed directly from the shock or stacked. The grain is generally stored on the farm and sold later at local elevators.

The seed bed is more thoroughly prepared for alfalfa than for other crops. It is plowed deep and thoroughly disked and harrowed. Seeding is done early in the fall. On some of the sandier soils, such as the Derby fine sandy loam and the Knox fine sand, alfalfa is frequently seeded with a nurse crop. The first cutting is usually made early in May, and four or five cuttings a year are usually obtained. Seed is often obtained from the second and third cuttings in dry seasons. Alfalfa hay is either stacked in the field for use on the farm or baled and sold. Alfalfa fields are sometimes pastured with hogs and horses. The varieties of alfalfa most commonly grown are the Lucerne and Turkestan.

No definite rotation of crops is practiced in Payne County. Little commercial fertilizer is used, but some farmers apply barnyard manure in small quantities. The farm equipment consists chiefly of two-horse walking plows and cultivators. A few three-horse sulkies are in use. There are six or eight tractors in the county, which are used for breaking the land with gang plows. The work stock generally consists of medium-weight grade Percheron horses.

Farm laborers are generally paid $25 a month with board, or $1.50 a day without board. Cotton pickers are usually paid 75 cents to $1 a hundred pounds. Except at harvest time most of the farm work is done by the farmer and members of his family.

According to the census, the average size of farms in the county in 1909 was 133.8 acres, of which 82.7 acres were improved. Practically the entire area of the county is in farms. In 1909, 49.1 per cent of the farms were operated by owners, 50.5 per cent by tenants, and 0.4 per cent by managers. Since the county was first settled the proportion of tenant farmers has steadily increased. The average cash rental of land is $2.37 an acre. By far the greater number of tenants rent on a share basis. Where the landlord furnishes the stock and implements and pays one-half the expenses he receives one-half the crop. Where the tenant furnishes everything except the land he pays the landlord one-third of the grain, one-fourth of the cotton, and one-half the alfalfa.

Prices of land for farming purposes in Payne County range from about $20 an acre in the rougher, more broken areas to $60 or $80 an acre in the bottom lands and near the larger towns. In a number of cases land values are very high, owing to the oil resources or prospects. The oil rights on a large percentage of the farms are leased to oil companies.

SOILS.

Payne County lies within the Great Plains soil province, as defined by the Bureau of Soils. The upland soils are derived principally from rocks of the Permian[1] and the Pennsylvanian divisions of the Carboniferous. Those of the western part of the county are derived from standstones and shales of the Permian Red Beds, and of the eastern part mainly from sandstones, shales, and limestones of Pennsylvanian age. The Pennsylvanian rocks are divided roughly into two groups, the Ralston and the Sapulpa. Most of the rocks of the Ralston group in Payne County are what are called red Pennsylvanian rocks, while the rocks of the Sapulpa group are generally of some other color.

[1] Geological data are taken from Bul. No. 7, Oklahoma Geological Survey, "Clays and Clay Industries of Oklahoma," by L. C. Snider.

The soils residual from the Permian Red Beds prevailingly partake of the color of the parent rocks and are classified in the Vernon series. The other important soil series, the Kirkland, coming from Permian rocks, is brown in color rather than red. Its difference in color is probably due to the long period of time during which it has been subjected to weathering. In the areas of red soils the topography is more rolling, the bedrock is much nearer the surface, and the soil is more subject to erosion than in the areas of brown soil, where the topography is gently sloping or nearly level.

The red Pennsylvanian rocks give rise to soils classed in three series, the Vernon, Kirkland, and Bates. The difference between the Vernon and Kirkland soils in color, topography, and drainage is the same as in the case of these soils where derived from Permian rocks. The Bates soils are topographically intermediate between the Vernon and Kirkland soils of the Permian area. They are better drained than the Kirkland soils, but less subject to erosion than the Vernon soils.

The nonred Pennsylvanian rocks, which occur in the extreme eastern part of the county, give rise principally to soils of the Bates series, but to some extent to Kirkland soils. The topography here is generally more rolling and the bedrock nearer the surface than elsewhere in the Pennsylvanian region.

Limestone occurs in Payne County in small developments in areas of both the red and the nonred Pennsylvanian rocks. The Summit series includes soils derived by weathering from this limestone. In a few places this rock contributes material to some of the other soils.

Payne County lies in a region where the soil-making forces produce at maturity of development a soil with a dark-brown, friable surface horizon with a rather well-developed granular structure and a low content of carbonates; an upper subsoil much heavier in texture than the soil, hard and intractable when dry and plastic when wet. This is underlain at about 2 feet by the upper part of the somewhat oxidized and leached but not thoroughly weathered parent rock. It is therefore a region of dark-colored soils with heavy clay-pan subsoils, these being the characteristics of the soil at maturity of development. These soils are developed on the areas with flat topography, since it is only in such areas that the soil material has lain in place long enough for soil-making forces to have brought the soils to an advanced stage of development. These soils have been identified as members of the Kirkland series. The soils of the whole county, regardless of the underlying formation, from the materials of which they are developing, will finally reach this stage and attain the same characteristics. This, however, is a very slow process and can not effect these results within a period of many

thousands of years. Indeed, there are to be observed in the region some facts indicating that within the recent past all the soils of the county had reached the Kirkland stage and that later these mature soils were eroded away and that younger soils, now in process of development, were formed in the more rolling areas of the county from which the older soils were removed in the course of the work of erosion that produced the rolling topography.

Between the mature soil mapped as Kirkland and the rather young upland soils mapped mainly as Vernon there are two series of soils whose characteristics indicate a stage of development considerably more advanced than the Vernon types and yet not so far advanced as those mapped as Kirkland. These soils of intermediate age belong in the Bates and Summit series; both occur on gently undulating surfaces; both are dark in color—usually somewhat darker than the Kirkland types—the Bates having no noticeable development of a claypan horizon and the Summit marked by a moderate development of such a feature.

The heavy subsoil phase of the Vernon silt loam has reached about the same stage of development as the Kirkland, but on account of its red color it is correlated with the Vernon series.

The rest of the soils of the county are young, or relatively so. Some of the Vernon types are little more than disintegrated rock material, with a relatively small accumulation of organic matter. They still retain the red color of the parent rock.

The free carbonates have been leached from the 3-foot soil profile throughout the county.

In texture the residual upland soils range from fine sandy loam to clay, with loam and fine and very fine sandy loams predominating. The subsoils are characteristically much heavier than the soils. The latter are generally mellow and friable, while the subsoils range from stiff and plastic to moderately friable, and even when friable are usually compact. The topography plays an important part in determining the subsoil structure. The stiff, plastic, and clay-hardpan subsoils occur in the more nearly level areas, where the rainwater escapes downward and has apparently caused a concentration of the finer textured soil particles in the subsoil. In many places, however, the compact, plastic, heavy subsoils are derived from finer textured rocks than are the more friable subsoils.

The Vernon series is characterized by reddish soils and chocolate-red subsoils. The subsoil material is usually compact, but crumbles readily between the fingers. The Vernon soils occupy ridges, slopes, and rolling areas, and are well drained. They predominate in central and western Oklahoma.

The soils of the Kirkland series are brown, and the subsoils light brown, brown, or reddish chocolate brown. The subsoil when dry is

characteristically very tough, constituting a clay hardpan. The topography of the Kirkland soils varies from level to gently rolling or undulating, and the surface drainage ranges from poor to good, varying with the topography. The stiff subsoil retards the internal circulation of air and moisture.

The Bates series is characterized by brown or dark grayish brown surface soils and yellowish-brown or mottled yellow, brown, and red, moderately friable subsoils. These soils occupy undulating to gently rolling areas which are generally treeless, except where the soils are sandy.

The soils of the Summit series are typically dark brown or black, underlain by yellowish or greenish-yellow subsoils. The latter usually consist of clay which is sticky when wet but slightly friable when moderately moist.

The nonresidual upland soils are of windblown origin. They are classed in the Knox and Derby series. These soils occur in a strip lying mostly north of the Cimarron River and extending brokenly from the western to the eastern county boundary. The surface soils are composed largely of fine sand and the subsoils of fine sand or fine sandy clay. Both surface soil and subsoil are friable.

The soils of the Knox series are light brown or grayish. They are underlain by yellowish or light grayish yellow subsoils which are usually of very nearly the same texture as the surface soils, or only slightly heavier.

The Derby series is characterized by light-brown or brown surface soils and reddish-brown, dull-red, or yellowish-red subsoils. Both soil and subsoil are friable. The Derby soils occupy level to undulating areas and slopes, usually between the upland and bottom land. They are well drained.

The alluvial soils of the county may be divided into two groups, those of the terraces or second bottoms and those of the first bottoms. The terrace soils were deposited by the streams on former flood plains. They now lie well above overflow level, while the first-bottom soils are subject to occasional inundation. The terrace soils consist of sediments washed from the area to the west of the Permian Red Beds, and from the Red Beds themselves. The first-bottom soils have a similar origin, but the Red Beds have contributed extensively to their composition, as is evident from their predominantly chocolate-red color. Wash from the Pennsylvanian rocks has entered largely into the composition of the bottom-land soils along the small streams in the eastern part of the county. The alluvial soils of the county are composed largely of very fine sand, silt, and, to a lesser extent, clay. They are generally friable. The terrace soils are classed in the Canadian and Reinach series and the first-bottom soils in the Yahola, Miller, and Osage series.

The brown color and friable nature of both soil and subsoil characterize the Canadian series. The subsoils are usually lighter brown than the surface soils, and frequently yellowish brown. The Canadian soils are usually well drained.

The Reinach series consists of reddish-brown soils underlain by chocolate-red or salmon-red, lighter-textured subsoils. The Reinach soils occupy terraces along streams which drain the Permian Red Beds and are the terrace equivalent of the Yahola soils.

The soils of the Yahola series are characteristically reddish brown or chocolate red in color. They are underlain by chocolate-red or salmon-red subsoils, which are always lighter in texture and generally more friable than the surface soils. The Yahola soils occur in the first bottoms along streams issuing from the Permian Red Beds. They are usually well drained. These soils are frequently calcareous.

The Miller series is similar to the Yahola in color, origin, and surface-soil characteristics, but differs in that the subsoil is as heavy as the surface soil, or heavier.

The surface soils of the Osage series are dark brown to black and the subsoils lighter colored, being grayish or brownish. These soils consist of alluvial wash from the sandstone, shale, and, to some extent, limestone soils of the Great Plains region. They are subject to overflows during periods of high water.

In following pages of this report the various soils mapped in Payne County are described in detail and discussed in their relation to agriculture. The following table shows the name and the actual and relative extent of each:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Vernon loam	82,944	24.1	Yahola silt loam	14,016	3.2
Heavy subsoil phase	24,448		Vernon clay loam	9,536	2.1
Vernon very fine sandy loam	56,000	19.9	Canadian loam	9,088	2.0
Shallow phase	32,512		Canadian very fine sandy loam	6,464	1.5
Bates fine sandy loam	20,544	8.9	Summit stony clay	4,928	1.1
Shallow phase	19,008		Osage silt loam	2,176	.5
Bates loam	35,584	8.0	Yahola silty clay loam	1,728	.4
Kirkland silt loam	34,176	7.7	Reinach fine sandy loam	1,024	.2
Yahola very fine sandy loam	27,904	6.3	Miller clay	832	.2
Derby fine sandy loam	26,752	6.0			
Kirkland loam	19,264	4.3	Total	444,800	
Knox fine sand	15,872	3.6			

VERNON VERY FINE SANDY LOAM.

The Vernon very fine sandy loam consists of a light reddish brown or chocolate-red very fine sandy loam, 5 to 15 inches deep, under-

lain by a chocolate-red, friable but generally compact, loam or clay loam which grades abruptly into a friable, chocolate-red clay. Over part of the type in the eastern part of the county the surface soil is brown rather than reddish brown. As mapped, the type includes some small areas of heavy soil, resulting from the removal of the sandy surface material by erosion, with consequent exposure of the subsoil. There are also included some small areas of Bates fine sandy loam and of Vernon very fine sandy loam, shallow phase, the latter occurring mainly in the western part of the county. In the vicinity of Willow Springs School, in the southwestern part of the county, and in several areas east of Cottingham the surface soil varies to the extent of being a fine sandy loam in places. Occasionally at the foot of slopes there is an accumulation of material which is fairly uniform in texture throughout the 3-foot section.

The Vernon very fine sandy loam is derived from the fine-grained sandstone of the Permian Red Beds in the western and central parts of the county and from reddish or grayish-red sandstones of Pennsylvanian age in the eastern part. The type is distributed throughout the county, being most extensive in the western and central parts. It generally occupies rolling uplands where drainage is well established. The type in most places lies a little higher than the Vernon loam, but it occurs at a somewhat lower elevation and in less hilly areas than the shallow phase of the very fine sandy loam.

At the present time about 45 per cent of this type is cultivated. The rest supports a growth of native grass and blackjack-oak timber. The principal crops grown are kafir, corn, cotton, oats, and hay. Potatoes are grown in a small way for sale on the local markets and for home consumption, and sorghum-hay crops, wheat, and alfalfa are grown on a few farms. More live stock is raised than on the Vernon loam. The forested areas and usually those supporting a growth of native hay are pastured during at least a part of the year. Beef and dairy cattle, horses, and mules are raised. Nearly every farmer keeps a few hogs to supply meat for home consumption and for sale on the local markets.

Ordinarily kafir and corn yield about 20 bushels per acre.[1] Kafir is a surer crop than corn, suffering less in dry weather, and it is gradually taking the place of corn. Cotton yields average one-third bale per acre, or about 600 pounds of seed cotton, but higher yields are frequently obtained. Oats average about 20 bushels per acre and wheat 10 bushels, Irish potatoes and sweet potatoes ordinarily yield 60 to 100 bushels per acre. Sorghum hay averages about 2 tons per

[1] Crop yields are based on records of the Oklahoma Agricultural and Mechanical College at Stillwater, on observations in the field, and on statements of farmers.

acre, prairie hay 1 ton, and alfalfa 1 to 2 tons per season, for 3 or 4 cuttings.

This soil is easily cultivated with light farming implements. It is generally plowed in the spring, owing to the fact that the soil in fall-plowed fields is apt to drift or to suffer from erosion during the winter months.

The average selling price of land of the Vernon very fine sandy loam is about $25 an acre.[1] Many improved farms sell for $30 to $37.50 an acre.

This soil is much in need of organic matter, which can be added by plowing under green-manure crops and by applying barnyard manure. Erosion on the slopes is frequently excessive. This can be prevented and the organic-matter content of the soil incidentally increased by growing some winter cover crop, such as rye, sweet clover, or alfalfa, to be plowed under in the spring. Contour plowing or terracing will aid in preventing erosion.

Vernon very fine sandy loam, shallow phase.—The shallow phase of the Vernon very fine sandy loam consists of a light-reddish very fine sandy loam to very fine sand, underlain by a chocolate-red subsoil which ranges from a rather heavy clay to a friable, loose, very fine sandy loam containing some disintegrated rock material. Bedrock, composed of red or red and grayish streaked, fine-grained sandstone, is ordinarily encountered at depths varying from 20 to 36 inches, but frequently the rock outcrops. Included with the type are some small areas of Vernon very fine sandy loam, stony fine sandy loam, and clay loam. There are also some small inclusions of a lighter colored soil which shows very little red, and which would be mapped with the shallow phase of the Bates fine sandy loam if sufficiently extensive.

The Vernon very fine sandy loam, shallow phase, occurs on the higher elevations and on slopes throughout the red upland sections, and is frequently very much broken. It is most widely distributed throughout the western part of the county. Only a small proportion of its area is cultivated. The rest is forested and constitutes the typical blackjack-oak land of the western and central parts of the county. The same crops are grown as on the typical Vernon very fine sandy loam, but yields are lower. Cattle and some mules and horses are pastured on the forested areas. The cattle subsist mostly on the native grasses, but are fed for short periods in the winter.

The average selling value of this land is from $15 to $20 an acre.

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

[1] Land prices stated exclude value of oil rights.

Mechanical analyses of Vernon very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
450703, 450723, 450729.	Soil.....	0.0	0.1	0.1	26.4	41.0	20.9	11.1
450704, 450724, 450730.	Subsoil.....	.2	.2	.1	19.3	35.2	28.0	16.8
450725, 450731.	Lower subsoil.	.0	.0	.0	26.3	47.9	16.0	9.5

VERNON LOAM.

The surface soil of the Vernon loam is a reddish-brown or chocolate-red loam or light loam, varying from 6 to 12 inches in depth. This is underlain by chocolate-red, compact but friable clay loam to clay, which sometimes contains small black concretions. The subsoil in some places becomes slightly more friable and lighter colored below a depth of 30 inches, owing probably to the presence of some partially decomposed rock material, as the bedrock in these areas lies within 3½ or 4 feet of the surface. In the areas of the type scattered over the eastern part of the county the surface soil is frequently a little less red than in the more typically developed areas in the western and central parts, owing to the derivation of the material from red or light-red sandstones and shales of Pennsylvanian age instead of the sandstones and shales of the Permian Red Beds which have given rise to the typical Vernon loam. As mapped, the type includes numerous small areas of Vernon very fine sandy loam and some spots of Vernon clay loam.

The Vernon loam occurs throughout the county. It is most extensive in the western two-thirds. The type occupies undulating to gently rolling uplands and sloping areas near streams in the more nearly level parts of the county. It is usually less hilly and lies at a lower level than the Vernon very fine sandy loam. Drainage is well established.

About 50 per cent of the type is cultivated. The remainder supports a growth of native grass and a few small patches of blackjack or post-oak timber. The most important crops grown are kafir, corn, oats, wheat, alfalfa, and native hay, ranking in importance in about the order named. Alfalfa is not grown as extensively as on the bottom-land soils. A small area is devoted to potatoes and garden truck for home consumption. Cows and hogs are kept in small numbers, but the fattening of cattle and the raising of horses and mules are carried on to a less extent than on some of the more broken soils.

The Vernon loam is one of the better upland types. The average yield of corn is between 20 and 25 bushels per acre. Kafir averages

about 20 bushels, oats between 25 and 30 bushels, and wheat about 12 bushels. Cotton yields range from one-third to one-half bale per acre. The average yield of alfalfa is about 2 tons per acre per season, and native hay 1 ton.

This soil is fairly easy to till. It is usually cultivated with two-horse implements. Fall plowing is practiced by a number of farmers, but some defer plowing until a short time before seeding in the spring. The more rolling areas are subject to erosion, and in some cases cultivating the soil in the fall and leaving it bare through the winter tends to accentuate this. No commercial fertilizer is used on the Vernon loam, but some farmers apply barnyard manure, with good results. Crops are not rotated to any extent.

The average selling value of land of this type is about $25 or $30 an acre. The range in value is from $20 to $50 an acre.

Yields on this soil can be increased by adding organic matter. A leguminous crop should be plowed under at intervals of a few years.

Vernon loam, heavy subsoil phase.—The heavy subsoil phase of the Vernon loam consists of a chocolate-brown to dark chocolate red loam or light loam, 6 to 10 inches deep, overlying a dark chocolate red, stiff, heavy clay. This in most places continues plastic and heavy throughout the 3-foot section, but occasionally it becomes slightly friable below 30 inches. In a few places red shale bedrock is encountered at about 30 inches. The subsoil in some areas is slightly mottled with yellowish in the lower part and becomes very hard and tough on drying, closely resembling the clay hardpan subsoil of the Kirkland series except in its more reddish color. Frequently lime concretions occur in the lower subsoil.

In some small areas several miles south of Stillwater and in a number of others scattered throughout the county, mostly in the north-central part, the surface soil is a silt loam and the lower subsoil is occasionally mottled with brown, yellowish red, or darker red in some of the more nearly level, poorly drained situations.

The Vernon loam, heavy subsoil phase. occurs throughout the county but is very inextensive in the eastern end. Most of the areas are comparatively small. The phase occurs on slopes and flat-topped elevations in association with other Vernon soils. It is derived largely from fine-textured shales and sandstones of the Permian Red Beds, and in the eastern part of the county from red shales and fine sandstone of Pennsylvanian age. Drainage is frequently deficient, owing to the slightly undulating or nearly level surface.

About 40 per cent of this phase is cultivated. The remainder is mainly in native grass. Some fields have apparently been abandoned to sunflowers and other weeds. The most important crops grown are kafir, corn, cotton, wheat, oats, and sorghum for hay. Almost every farmer keeps a few cattle and hogs, and some raise a small

number of horses and mules. Kafir yields about 18 bushels per acre, corn about 20 bushels, wheat 12 bushels, oats 20 bushels, native hay 1 ton, and sorghum hay 2 tons. About the same cultivation is required as on the Kirkland soils. The phase is not subject to erosion to the same extent as the more rolling soils of the Vernon series, and fall plowing gives better results. Deeper plowing in the fall and the growing and plowing under of green crops would probably increase yields on this soil.

Land of the Vernon loam, heavy subsoil phase, is held at $20 to $25 an acre.

VERNON CLAY LOAM.

The Vernon clay loam consists of a dark chocolate red to dark brownish red clay loam about 6 inches deep, or a dark brownish red loam or very fine sandy loam 2 or 3 inches deep, underlain by dark chocolate red, heavy clay. In many areas bedrock is encountered within the 3-foot section, and elsewhere it occurs just below this depth. The subsoil frequently continues heavy and plastic throughout the 3-foot section, but in many places, especially where bedrock occurs within 3 feet of the surface, the lower subsoil is somewhat friable and may contain a small percentage of disintegrated rock material. The subsoil is frequently calcareous, and in many of the more eroded places lime concretions appear on the surface. In one area 4 miles east of Ingalls the surface soil is dark brown and the subsoil yellowish brown or yellowish red, except near gullies and on elevations, where the material is more typical of the Vernon clay loam. This soil is calcareous and would probably be mapped with the Summit clay loam if such a type were recognized in this county.

The Vernon clay loam is derived largely from shales of the Permian Red Beds. It generally occurs on slopes, and represents eroded areas of other Vernon soils. It is mapped throughout the county in small areas.

The type is not extensively cultivated, owing to its heavy, tenacious nature and its general occurrence on eroded slopes. In the more favorably located areas, with proper cultivation, fair yields of cotton and corn are obtained. In depressions where there is an accumulation of moisture 2 tons or more of sorghum hay per acre are produced.

This soil can be made more productive by thorough cultivation and the adding of organic matter. The incorporation of vegetable matter will do much toward preventing excessive compaction of the soil and consequent loss of moisture by evaporation at the surface.

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

Mechanical analyses of Vernon clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
450760	Soil	0.0	0.1	0.1	22.1	24.6	24.7	28.2
450761	Subsoil	.9	1.4	.4	9.4	14.0	35.0	38.9

The following sample contained more than one-half of 1 per cent calcium carbonate ($CaCO_3$) : No. 450761, 7.54 per cent.

KIRKLAND LOAM.

The surface soil of the Kirkland loam is typically a brown or dark-brown, mellow loam, varying in depth from 8 to 15 inches. In some places in the eastern part of the county the surface soil is brownish gray rather than brown. At a depth of 8 to 15 inches the soil usually passes abruptly into a heavy, tenacious, hard clay subsoil. This is usually dark brown in the upper part. Below a depth of 10 or 12 inches it becomes brown with yellow or yellow and red mottlings. In some places, at a depth of about 30 inches, it is dull red. In a small number of depressed areas the subsoil is nearly black, becoming gray or drab with some faint yellow mottlings at a depth of 24 to 30 inches. In some areas in the eastern part of the county near Cushing and Yale the transition from soil to subsoil is not so abrupt as typical. The soil at about 12 inches passes gradually into a brown or dark yellowish brown clay loam which grades into the characteristic hard subsoil at 20 or 22 inches. As mapped there are included with the type some small areas of Kirkland very fine sandy loam.

The Kirkland loam is derived from comparatively low-lying sandstones and shales of Permian and Pennsylvanian age. It occurs chiefly in the central and eastern parts of the county, but a few areas are scattered over the western part. The type occupies undulating to nearly level uplands. The surface is a little more sloping than that of the Kirkland silt loam and the drainage is somewhat better although in places it is insufficient.

About two-thirds of the type is in cultivation, and the remainder supports a growth of prairie grass, while a few fields once cultivated have been abandoned. The principal crops grown are kafir, corn, oats, cotton, wheat, and hay. Stock raising is developed to about the same extent as on the silt loam. Yields are practically the same as those obtained on the latter type, except that in unusually wet years crops are apt to do slightly better on the loam.

The range in land values on the Kirkland loam is from $15 to $45 an acre, depending upon the location and improvements. The average selling price is between $25 and $30 an acre.

The productiveness of the Kirkland loam can be increased by gradually plowing to a greater depth and by adding organic matter.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Kirkland loam:

Mechanical analyses of Kirkland loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
450780, 450714.....	Soil.....	0.1	0.5	0.4	11.7	30.4	40.9	15.9
450781, 450715.....	Subsoil.....	.3	.4	.2	6.8	22.9	43.7	25.7

KIRKLAND SILT LOAM.

The Kirkland silt loam consists of 6 to 15 inches of brown, grayish-brown, or dark-brown silt loam, underlain abruptly by a tenacious, heavy clay, which is plastic when wet and very hard and compact when dry. The clay subsoil is brown or dark brown in the upper part, and brown usually mottled with yellow, gray, and red in the lower part. Where the heavy "hardpan" or "claypan" lies more than 12 or 15 inches from the surface the soil immediately above it is usually as heavy as a silty clay loam, but in the areas of shallower surface soil the transition from the silt loam soil to the hard clay subsoil is more abrupt.

In some places the lower subsoil is yellow and brown mottled, and in others it is dull red mottled with brown or gray. The reddish subsoil color occurs in slightly elevated situations within or bordering more nearly level areas. In some depressed areas, especially south of Stillwater, the subsoil is extremely plastic and nearly black in the upper part, but gradually becomes lighter colored with increase in depth, generally being mottled with rusty brown or yellowish gray in the lower part of the 3-foot section.

In an area about the town of Norfolk the soil varies from typical in occupying a terracelike position. This area is level and poorly drained. It is cultivated mainly to cotton, kafir, and corn, and yields are rather low.

In the eastern part of the county the areas of Kirkland silt loam, which are associated closely with the Summit stony clay, are influenced in places by limestone. In other areas, too, the soil in patches is underlain by limestone sufficiently near the surface to influence to a small extent the character of the material. Alkali spots occur in places. Where the subsoil of such areas is exposed to the air, as in ditch banks and gullies, it has a light-gray appearance.

The Kirkland silt loam is derived largely from the finer grained sandstones and shales of Permian age. It owes its comparative ab-

sence of red color to the comparatively poor drainage resulting from the nearly level surface and relatively low position. On account of the prevailing lack of surface relief the soil has not been subject to erosion such as has been constantly carrying away the old material from the Vernon soils and allowing them to be renewed by weathering of the underlying rocks. Drainage is frequently rather poor, but in many places the slope is steep enough for adequate drainage, and some areas occur in comparatively elevated places at the heads of draws. The type is encountered mostly in the central part of the county.

About 30 per cent of this soil is cultivated. Most of the uncultivated area supports a growth of prairie grasses, which are cut over for hay. The principal crops grown are kafir, oats, corn, cotton, wheat, prairie hay, and sorghum hay. In the vicinity of Stillwater dairying is carried on to some extent. Horses, mules, and hogs are raised in small numbers. Kafir yields 15 to 30 bushels per acre, averaging about 20 bushels. Oats yield 25 to 30 bushels, corn 20 to 22 bushels, and wheat about 12 bushels. Native hay yields 1 ton or more per acre, and sorghum hay 2 or 3 tons, and occasionally even more. The soil is fairly easy to cultivate, except in areas where the subsoil is near the surface. Many farmers plow in the fall. Subsoiling has not generally proved profitable, as the subsoil material compacts again on becoming wet. No systematic rotation of crops is practiced.

The average selling value of this land is between $25 and $30 an acre. Land near the larger towns may bring $45 an acre.

This type of soil can be improved by gradually increasing the depth of plowing and by incorporating organic matter. It seems better adapted to shallow-rooted crops, such as small grains, peanuts, and sorghum, than to deep-rooted crops like alfalfa and cowpeas.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Kirkland silt loam:

Mechanical analyses of Kirkland silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
450718	Soil	0.2	0.2	0.2	7.2	24.3	50.0	17.6
450719	Subsoil	.0	.3	.2	10.2	24.3	39.7	25.1

BATES FINE SANDY LOAM.

The Bates fine sandy loam consists of a brown to dark-brown loamy fine sand to fine sandy loam, underlain at depths varying from 10 to 18 inches by a subsoil of mottled reddish and yellowish sandy clay or brownish-yellow, friable sandy clay. The subsoil becomes mottled

with red, yellow, and sometimes gray in the lower part. Frequently below 28 or 30 inches it is somewhat plastic and more compact than in the upper part. As mapped the type includes some small areas of reddish soil that would be mapped as Vernon fine sandy loam if more extensive. There are also included some small areas of Bates loam, Bates very fine sandy loam, and the shallow phase of the Bates fine sandy loam.

The Bates fine sandy loam is derived from sandstones of Pennsylvanian age. It occurs principally in the eastern one-third of the county, but smaller areas are encountered west of Marena and northwest of Stillwater. The largest areas occur east of Yale, in the extreme eastern end of the county, and east of Glencoe, in the northeastern part. The surface varies from undulating to rolling, and the type is in most places well-drained. Between 40 and 50 per cent of it is in cultivation. About one-half of the untilled land is in prairie grass. The remainder supports a tree growth consisting chiefly of blackjack oak and turkey chestnut oak. Oats, kafir, corn, and hay are the principal crops grown. Cotton is grown on some farms. Cattle are grazed on pastures of prairie grasses and in the forested areas. Oats and kafir yield about 20 bushels per acre, and corn about 18 bushels. Prairie grasses yield about 1 ton of hay per acre, and sorghum about 2 tons. Yields of 400 to 500 pounds of seed cotton are obtained per acre. The soil is easily cultivated, and only the lightest farming implements are used.

This land is valued at $18 to $30 an acre, the price depending on the nearness to markets and the suitability for cultivation.

The addition of organic matter by the application of barnyard manure and the plowing under of green cover crops should increase the productiveness of this soil. Care should be taken to prevent erosion.

Bates fine sandy loam, shallow phase.—The shallow phase of the Bates fine sandy loam differs from the typical soil chiefly in that bedrock comes within 3 feet of the surface. The soil is usually a brown, loamy fine sand in the first 3 or 4 inches, underlain by a light-brown loamy fine sand to fine sand which continues to 10 or 12 inches. Below this depth the subsoil varies from a friable, mottled yellowish and reddish or mottled brownish-yellow, grayish, and reddish sandy clay to a loamy fine sand containing particles of disintegrated rock. At depths varying from 18 to 30 inches yellowish sandstone is usually encountered, and it frequently outcrops at the surface. In several areas in the southeastern part of the county the texture of the soil in places ranges to a very fine sandy loam. In areas along the eastern county boundary south of the Cimarron River and north and west of Schlegel the soil is frequently reddish along draws and in eroded places, and limestone occasionally occurs

interbedded with the sandstone on the slopes to streams, giving rise to small included areas of Summit soils.

The shallow phase of the Bates fine sandy loam occurs chiefly in the eastern third of the county. The largest areas are mapped east of Cushing and in the vicinity of Yale. The surface is generally broken, and drainage is excessive. Scattered patches where the surface is less broken and the bedrock not so near the surface are cultivated to corn, cotton, oats, or kafir. The uncultivated areas are forested with blackjack oak, scrub oak, and runner oak. Grass grows fairly well in the woods, and a number of cattle are grazed. Crop yields are lower than on the typical Bates fine sandy loam, and the land generally sells for about $5 less an acre. The soil can be improved by the addition of vegetable matter. The phase as a whole can be most profitably used as grazing land.

BATES LOAM.

The surface soil of the Bates loam is a brown, light or medium textured loam, varying in depth from 8 to 18 inches. It is most commonly of the shallower depth. The soil passes gradually into a yellowish-brown or brown and yellowish mottled, friable clay loam or clay, which changes to a fairly friable, yellow and red mottled clay at depths varying from 24 to 30 inches. In some places the lower subsoil is uniformly yellowish red. In other areas no red color is encountered within the 3-foot section. In a few places in the eastern part of the county where the type is closely associated with soils of the Kirkland series the lower subsoil is more plastic and heavy than is typical of the Bates. In some small areas, especially in the vicinity of Yale, the type is influenced by limestone. Several small developments of Bates silt loam are included with the Bates loam. The largest of these occurs in secs. 11 and 12, T. 18 N., R. 5 E. Smaller areas occur east of Cushing.

The Bates loam occurs in undulating to gently rolling upland areas scattered over the eastern part of the county. In general the type is well drained. The largest developments are mapped near Cushing. Two small areas occur in the western part of the county just northwest of Marena, and larger areas are mapped between Stillwater and Perkins and in the three most northern townships of the county.

About 50 per cent of the type is cultivated. The remainder supports a growth of prairie grass, with clumps of blackjack oak in a few places. Kafir, corn, oats, cotton, and wheat are the principal crops. Some sorghum is grown for hay. A few farmers have tried Sudan grass, with good results. Vegetables are grown on practically every farm, mainly for home use. A few cattle and hogs are kept by most farmers. Near Cushing and Yale a few farmers keep small dairy herds, selling milk and butter to hotels and families in the towns. Some flocks of sheep are maintained on this soil.

Kafir yields 20 to 25 bushels per acre, corn an average of about 25 bushels, oats 15 to 40 bushels, and wheat 12 to 14 bushels. The average yield of cotton is about one-third bale per acre. Native hay yields 1 ton or more an acre, sorghum hay 2 to 5 tons, and Sudan grass about 3 tons.

This soil is fairly easy to cultivate, and it is generally worked with light implements. The type is frequently plowed in the fall.

Land of the Bates loam generally sells for about $30 an acre. Improved farms near the larger towns are held at somewhat higher prices. Less well located farms occasionally sell for $20 to $25 an acre.

SUMMIT STONY CLAY.

The surface soil of the Summit stony clay is a dark-brown or nearly black clay, 6 to 10 inches in depth. There is frequently a 2 or 3 inch layer of dark-gray or nearly black loamy material on the immediate surface. The subsoil is a yellowish-gray or slightly greenish yellow clay, rather heavy and plastic and always very calcareous. Small limestone fragments usually are more or less abundant on the surface and generally throughout the soil section, and frequently bedrock is encountered between depths of 18 inches and 3 feet. In some places limestone rock outcrops at the surface. There are included with the type some small areas of red calcareous clay derived from red shales which are closely associated with the interbedded gray limestone and calcareous shales giving rise to the Summit stony clay. In some areas the soil is not very uniform, sandstone material being mixed with limestone material and giving rise to small included areas of slightly sandy or loamy material which is generally somewhat calcareous.

The Summit stony clay is not very extensive. It occurs in small areas, chiefly in the eastern part of the county. It is of little importance agriculturally, owing to its general occurrence on ridges and slopes and to its stony character. Numerous areas varying from a fraction of an acre to 1 or 2 acres in extent are sufficiently level and stone-free for cultivation, and are devoted to cotton, corn, and occasionally alfalfa. Frequently where the type occurs on both sides of small drainage-way depressions the soil on the lower slopes, consisting largely of colluvial material from the higher lying limestone soil, is devoted to alfalfa. Acreage yields of 3 tons per season are often obtained. Uncultivated areas support a good quality of prairie grass, on which cattle are grazed.

KNOX FINE SAND.

The surface soil of the Knox fine sand, extending to a depth of 6 to 12 inches, is a light-brown to brownish-gray fine sand or, in some cases, loamy fine sand. This is underlain by a pale-yellowish or

brownish-yellow, loose, fine sand which continues to a depth of 3 feet or more. In a few cases where the type occurs on ridges in the Cimarron River bottoms the subsoil has a faint pinkish tinge, which indicates that the material was blown up from the reddish soils of the river bottoms.

This type occurs mainly on sloping areas between the river bottoms and the Derby and high-terrace Canadian soils. In many places it occupies irregular ridges and hummocks, which clearly indicate wind action. Some areas are comparatively level. The type occurs almost exclusively along the north side of the Cimarron River, in an almost continuous development from the eastern to the western border of the county.

Only a small proportion of the type is cultivated, principally the more nearly level areas and depressions where there has been a greater accumulation of organic matter than in the more rolling situations. The uncultivated areas are forested principally with blackjack oak, post oak, and black oak. Near the depressions there are frequently elm, cottonwood, and walnut trees. Cotton, corn, and kafir are the principal crops grown. Some sorghum is grown for forage, and a few small fields are devoted to alfalfa and cowpeas. The loose structure of the subsoil causes leaching to such an extent that yields are comparatively low. Apple, peach, and pear trees give good returns when properly cared for, but the orchards usually are carelessly sprayed and pruned, and are hardly profitable. Cattle are grazed in the forested areas. The farmers who engage most extensively in cattle raising are generally the most prosperous. About 400 pounds of seed cotton is generally obtained per acre. Corn and kafir generally yield about 15 bushels per acre.

The average selling value of this land is between $15 and $20 an acre.

The liberal incorporation of vegetable matter would increase the water-holding capacity of this soil and make it more productive.

DERBY FINE SANDY LOAM.

The surface material of the Derby fine sandy loam varies from brownish gray to dark gray in color, being darkest in uncultivated areas, where the soil still contains vegetable matter in the form of leaf mold and the decayed roots of grasses. It is usually a loamy fine sand or fine sand. Below a depth of 6 to 8 inches the soil becomes a light-brown or brownish-yellow fine sand, and at depths varying from 16 to 24 inches passes into a dull-red sandy clay or clayey sand. In areas bordering the upland northwest of Perkins the subsoil is reddish yellow, but it becomes gradually redder until at a short distance to the south the typical dull-red color is again encountered.

The Derby fine sandy loam occupies an intermediate position between the Canadian and Knox soils or slopes between the Canadian soils and the first bottoms. It occurs in an almost continuous development on the north side of the Cimarron River.

Probably 60 per cent of the type is cultivated, the rest being mostly forested with blackjack and scrub oak. The principal crops grown are kafir, oats, corn, and cotton. Some alfalfa is grown. There are a few fruit trees on most farms, and blackberries, dewberries, and strawberries are grown to some extent. Irish potatoes and sweet potatoes are grown more extensively than on most of the other soils. Cattle are generally grazed on the forested areas, and some dairying is done in the vicinity of Perkins and southeast of Yale. Corn frequently yields 40 bushels per acre, but the average yield is nearer 30 bushels. Cotton yields two-thirds to 1 bale per acre, averaging about one-half bale of lint or 750 pounds of seed cotton. Kafir yields about 20 bushels per acre, and oats 30 bushels. Alfalfa frequently gives 3 tons of hay per acre per season, usually with 4 cuttings. Yields of Irish potatoes range from 75 to 150 bushels per acre.

Land of the Derby fine sandy loam is valued at $25 to $75 an acre, the price depending on the improvements and nearness to town. The average selling value is about $37 an acre.

This soil is apparently in need of more organic matter. In many instances continuous cultivation to one crop has decreased the productiveness, and the use of a crop rotation including a legume such as alfalfa or cowpeas would be beneficial. The growing of clean-cultivated crops allows the removal of some of the surface soil by the wind, and these crops should be alternated with crops that require no cultivation. Plant residues and cover crops should occasionally be worked into the soil, to make it more resistant to wind erosion.

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

Mechanical analyses of Derby fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
450757	Soil	0.0	2.7	8.8	50.2	20.9	13.7	3.8
450758	Subsoil	.0	2.4	8.3	59.0	19.0	8.3	2.5
450759	Lower subsoil.	.0	2.4	7.3	47.8	14.4	6.8	21.2

CANADIAN VERY FINE SANDY LOAM.

The surface soil of the Canadian very fine sandy loam is a brown very fine sandy loam, 10 inches deep. This is underlain by a lighter brown or yellowish-brown, friable loam which in some places extends with very little change to a depth of 3 feet or more and in other places changes to a friable clay loam below a depth of 28 or 30 inches. In some areas closely associated with the Derby fine sandy loam the lower subsoil has a reddish color, especially along the margins of areas bordering the Derby soil. Over part of the area southeast of the I-X-L School the soil is a fine sandy loam. In some places the immediate surface material has been slightly influenced by wind action.

This soil occurs on terraces north of the Cimmaron River. Areas are scattered from the western to the eastern boundary of the county. The surface is not quite so flat as that of the Canadian loam. It varies from nearly level to gently undulating.

About 85 per cent of the type is cultivated. Part of the remainder is forested with some small oak. The same crops are grown as on the Canadian loam. Yields in most cases are slightly below those obtained on the loam, but oats give a slightly higher average yield than on the loam. Apples and peaches do well on this soil. Live stock is not raised extensively.

The average selling value of land of the Canadian very fine sandy loam is about $50 an acre.

This soil can be made more productive by following a systematic crop rotation. This should include a legume, preferably alfalfa.

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

Mechanical analyses of Canadian very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
450753	Soil	0.0	0.3	1.4	23.7	37.4	28.6	8.8
450754	Subsoil	.0	.4	1.8	26.8	29.2	26.4	15.3

CANADIAN LOAM.

The surface soil of the Canadian loam is a brown, mellow loam, 10 or 12 inches deep. This grades into a slightly lighter brown, friable loam which becomes gradually heavier until at 24 or 30 inches it is a fairly friable, yellowish-brown clay loam. This lower subsoil is somewhat more compact than the upper subsoil, but it is not nearly so compact as the subsoils of the upland types. Some small

areas of silt loam are mapped with the Canadian loam, principally near Clarkson and in sec. 14, T. 18 N., R. 6 E.

The type occurs on high terraces back from the Cimarron River. In the southwestern part of the county it lies as much as 200 feet above the river bottom land in places, but south of the river and in the vicinity of Perkins it may lie only 50 to 100 feet above. The surface is nearly level, but owing to the high position there is fairly good surface drainage, and the friable nature of the subsoil permits of satisfactory underdrainage. The type in some places lies higher than near-by upland soils, owing to the fact that it has escaped erosion.

Nearly all of the type is cultivated, and it is one of the most productive soils in the county. It is devoted mainly to cotton, corn, wheat, and alfalfa. Some oats and kafir are grown, and small areas are devoted to grapes, blackberries, dewberries, and strawberries. Apples, peaches, and pears are produced to some extent. A few cows and hogs are raised on each farm. Cotton yields average slightly more than one-half bale per acre. Corn ordinarily yields 35 to 40 bushels per acre, but yields of 60 bushels or more are frequently obtained. Wheat occasionally yields as much as 25 bushels per acre, but it averages about 15 or 18 bushels. Kafir yields an average of about 25 bushels per acre and oats about 30 bushels. Alfalfa yields 3 to 5 tons of hay per acre, in 4 or 5 cuttings per season.

The soil works up easily and does not clod. Fall plowing is more generally practiced than on the upland types. The average selling value of the land is about $60 an acre. Some of the most highly improved, best located farms are held for as much as $100 an acre.

A number of farmers on this type have grown one crop on the same field until the productiveness of the soil has decreased. A systematic rotation should be followed. Alfalfa does exceptionally well on this soil, and it should be included in a rotation.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Canadian loam:

Mechanical analyses of Canadian loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
450774	Soil	0.0	1.4	3.8	15.0	30.2	37.1	12.4
450775	Subsoil	.0	1.4	4.2	15.2	28.0	36.8	14.4

REINACH FINE SANDY LOAM.

As mapped in Payne County the Reinach fine sandy loam is rather variable in composition. The surface material ranges from a red-

dish-brown to Indian-red fine sandy loam or very fine sandy loam, 6 to 16 inches deep. This is frequently underlain by a slightly heavier subsurface layer of reddish-brown material which is generally a loam in texture, but in some cases a heavy, very fine, sandy loam or fine sandy loam. In the coarser textured areas this heavier subsurface layer is practically lacking. The subsoil is typically a reddish fine sand or very fine sandy loam. In some places it becomes a pale-reddish, loose, fine sand below 28 or 30 inches. Included with the type are a few areas with a rather loamy surface soil. In these areas the sandy subsoil is not generally encountered within the 3-foot section, but a sandy layer usually occurs below this depth and the soil differs very little from typical. Such areas occur south of Stillwater and 1 mile south of Willow Springs School in Paradise Township.

The Reinach fine sandy loam occurs in small, fairly level terrace areas along some of the creeks and the Cimarron River. The largest areas are encountered southeast of Stillwater and on both sides of the Cimarron River in the vicinity of the Cushing-Yale Bridge. The type is well drained, and in some areas where the subsoil is more than ordinarily porous the underdrainage is apt to be excessive in dry weather.

Practically all of the type is cultivated. Corn, cotton, and alfalfa are the leading crops. Yields are higher than the average for the county, but slightly below the average for the bottom-land soils of the Yahola series, which are similar to the Reinach in general characteristics but occupy a lower position.

The Reinach fine sandy loam occupies such small areas that it is generally sold with other soils. The selling value of the land ranges from $35 to $60 an acre.

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

Mechanical analyses of Reinach fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
450762	Soil	0.4	3.4	6.4	36.8	29.4	18.3	5.2
450763	Subsoil	.2	1.6	5.7	76.4	10.8	3.5	1.9

YAHOLA VERY FINE SANDY LOAM.

The surface soil of the Yahola very fine sandy loam is typically a reddish-brown or chocolate-red very fine sandy loam, varying in depth from 12 to 20 inches. Immediately below the surface soil there

is usually a heavier layer, varying from 1 to 10 inches in thickness. This layer is Indian red or a reddish brown in color and generally a loam in texture, but in some places it is as heavy as a clay and in oth-ers as light as a heavy very fine sandy loam. The subsoil, underlying this layer and occurring immediately below the surface soil where the heavier subsurface layer is absent, consists of an Indian-red or salmon-red very fine sand or fine sand, which frequently becomes very much looser in structure and lighter in color at about 30 inches.

A few narrow strips of Yahola very fine sand along the river front are included with the type as mapped. In some places along the creeks and smaller branches, especially where the upland soils belong largely to the Bates series, the Yahola very fine sandy loam is lighter in color than is characteristic, and the soil is occasionally a fine sandy loam in texture. The most noticeable of these lighter textured areas occur along Euchee Creek in the southeastern part of the county and along a small stream north of Pleasant Grove school to the east of Glencoe. In the areas along the Cimarron River the subsoil and occasionally the surface soil are calcareous, while the material in the creek bottoms is noncalcareous.

The Yahola very fine sandy loam is largely composed of material residual from the Permian Red Beds. It occurs most extensively along the Cimarron River. Areas are encountered along practically all the streams which are large enough to have flood plains. The type usually occurs along the stream fronts and lies slightly higher than the associated bottom-land soils. The surface in general is level, but in a few places along the Cimarron River it is slightly relieved by swales and low hummocks. The type is very seldom overflowed, especially along the smaller streams, and its drainage is generally good.

Probably 70 or 80 per cent of the type is cultivated. The principal crops are corn, cotton, alfalfa, and kafir. Sweet potatoes, oats, wheat, and watermelons are grown to some extent. The uncultivated areas are generally forested. Cottonwood, wild plum, and shrubs are the most common growth on the most recently deposited areas along the river, while bur oak, chestnut oak, elm, walnut, or sycamore are found along the smaller streams. Some pecan trees grow on this soil, and yield a very good quality of thin-shelled nuts. Some cattle and hogs are raised.

Corn yields average between 30 and 40 bushels per acre. Cotton yields one-half to 1 bale per acre, alfalfa 3 to 5 tons of hay per season, of $\frac{3}{4}$ to 1 ton per cutting, and kafir 20 to 35 bushels. The soil is easily cultivated and only light implements are required. The selling value of the land ranges in general from $40 to $75 an acre.

YAHOLA SILT LOAM.

The Yahola silt loam to a depth of 6 to 18 inches consists of a brownish-red or Indian-red silt loam to fine loam. Below this occurs a heavier layer, 4 to 12 inches thick, consisting generally of Indian-red silty clay loam. This subsurface layer rests upon Indian-red or salmon-red very fine sandy loam or very fine sand which occasionally passes at about 30 inches into loose, light-reddish fine sand. This continues to a depth of 3 feet or more. In two or three small areas the sandy subsoil is not encountered within the 3-foot section. If these areas were sufficiently large they would be mapped as Miller silt loam.

The Yahola silt loam occurs as first-bottom land, subject to occasional overflow, along the Cimarron River and the larger creeks. It usually lies between the Yahola very fine sandy loam and the upland. In areas where it occurs associated with a heavier type the latter lies next the upland, and the Yahola silt loam occupies an intermediate position between the heavier type and the Yahola very fine sandy loam. As in the case of the latter type, the areas along the Cimarron River are calcareous in the subsoil and occasionally in the surface soil, while the type in the creek bottoms is neutral to litmus paper. This difference is due to the fact that the river-bottom soils consist largely of material washed from the decidedly calcareous areas of Vernon soils in western Oklahoma, while the alluvium in the creek bottoms has been derived from the Vernon soils of the eastern part of the Red Beds region, which are in general noncalcareous. The creek-bottom soils are not acid, however, and they are generally considered to be equally as productive as those of the river bottoms.

The surface of the Yahola silt loam is nearly flat, and the surface drainage is at times deficient, but the porous nature of the subsoil offsets this by affording excellent underdrainage. Although the type is not extensive it is important agriculturally. Probably 80 per cent of it is cultivated. Most of the uncultivated areas are forested. The most important crops grown are alfalfa, corn, cotton, wheat, oats, and kafir. Some cattle are grazed in the wooded areas and in alfalfa and native pastures. Some farmers find it profitable to pasture hogs on alfalfa. This legume yields 3 to 5 tons of hay per acre per season. Cotton yields range from one-half to 1 bale or more per acre. Corn yields 20 to 50 bushels, averaging about 35 bushels. Wheat yields 15 to 25 bushels, oats 30 to 35 bushels, and kafir 25 to 30 bushels. The soil, although comparatively heavy, does not clod badly and is fairly easy to cultivate.

Land of the Yahola silt loam ranges in selling value from $30 to $80 an acre.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Yahola silt loam:

Mechanical analyses of Yahola silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
450750	Soil	0.0	0.0	0.0	0.6	30.8	48.4	20.0
450751	Subsoil	.0	.0	.0	.8	7.2	45.8	46.3
450752	Lower subsoil.	.0	.0	.0	48.3	40.4	5.8	4.8

The following samples contained more than one-half of 1 per cent calcium carbonate ($CaCO_3$): Nos. 450750, 2.47 per cent; 450751, 4.22 per cent; 450752, 2.11 per cent.

YAHOLA SILTY CLAY LOAM.

The surface soil of the Yahola silty clay loam is a dark brownish red or reddish-brown silty clay loam, 4 to 8 inches deep. This is generally underlain by brownish-red or salmon-red silty clay loam or heavy silt loam, passing at 20 to 24 inches into brownish-red very fine sandy loam. This usually continues to a depth of 3 feet or more, but in some areas it passes into a light-red fine sand at 32 to 36 inches. In a few places the subsurface soil is a silty clay or clay. In parts of one or two areas the subsoil is not uniformly sand, thin layers of silty clay loam or clay being interbedded with thicker layers of very fine sandy loam. The areas along the Cimarron River are calcareous in the subsoil and occasionally in the surface soil, but in the creek bottoms the material is neutral to litmus paper.

The Yahola silty clay loam occurs in small areas along the Cimarron River and along Stillwater Creek and other streams. It is most extensive near the town of Stillwater. The surface is level and the surface drainage is apt to be poor, but the lighter textured subsoil allows good underdrainage. The greater part of the type is cultivated. The same crops are grown as on the Yahola silt loam. Yields in wet years are generally lower than on the silt loam, owing to the poorer drainage, but in dry years crops frequently do slightly better than on the silt loam, owing to the greater water-holding capacity. The type is rather heavy to cultivate. It clods to some extent, and thorough tillage is necessary to obtain maximum yields. The selling value of the land is about the same as in the case of the Yahola silt loam.

The results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Yahola silty clay loam are given in the following table:

Mechanical analyses of Yahola silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
450720	Soil	0.0	0.0	0.0	1.0	20.1	54.6	24.0
450721	Subsoil	.0	.0	.0	.7	27.2	46.4	25.6
450722	Lower subsoil.	.0	.0	.0	6.3	53.7	26.6	12.8

MILLER CLAY

The surface soil of the Miller clay is typically a dark Indian red clay, 7 inches deep. It is underlain by an Indian-red, rather heavy, plastic clay, which continues to a depth of 3 feet or more. The surface soil of part of the type as mapped in Payne County is a heavy silty clay loam rather than a clay. In a poorly drained area east of Progress School, 6 miles west of Perkins, the surface soil is almost black. In some places in the area west of Stillwater, in the Stillwater Creek bottoms, a darker layer occurs in the subsoil between the depths of 24 and 28 inches. The areas of the type in the Cimarron River bottoms give a slight calcareous reaction with hydrochloric acid in the lower part of the subsoil, but the type in the creek bottoms does not effervesce with acid and seems to be about neutral.

The Miller clay occurs as first-bottom land subject to occasional overflows. It lies rather far back from the streams in the Stillwater Creek and Cimarron River bottoms. The type is of small extent and relatively unimportant. It is adapted to the same crops as the Yahola silty clay loam. Yields are good, but usually below those obtained on the latter type. Cotton does not do especially well when the season is late. The soil is rather difficult to cultivate, owing to its heavy, plastic nature, and thorough cultivation is necessary. This land is valued at about $50 an acre.

OSAGE SILT LOAM.

The surface soil of the Osage silt loam is a brown or dark-brown to nearly black silt loam, 8 to 16 inches in depth. The organic-matter content is frequently rather high, and considerably influences the color of the soil. Cultivated areas where the vegetable matter has been partly used up by crops are generally lighter in color than areas that are still in sod or are timbered. The subsoil consists of a friable, heavy silt loam or loam, gray or brown in color, changing to a compact, though friable, silty clay loam or clay at 24 to 36 inches. As mapped the type includes a few small areas with a loam surface soil. In secs. 21 and 22, T. 18 N., R. 4 E., a

rather heavy area of Osage silty clay loam is included. Some other included areas have a brownish-red silty clay subsoil.

The Osage silt loam occurs as first-bottom land along some of the streams in the eastern and northern parts of the county. The most extensive areas occur along Salt, Euchee, and Long Branch Creeks. The type is fairly well drained, as it generally lies 8 or 10 feet above the water level of the streams. These very seldom overflow their banks. About two-thirds of the type is cultivated. The remainder either supports a growth of native grass or is forested with oak, elm, and brush. The cultivated areas are planted principally to corn and cotton. Some alfalfa is grown. Hay is cut from the areas still in grass, and cattle are grazed in the timbered areas. Corn yields 30 to 40 bushels per acre in average years, cotton about one-half bale, and alfalfa 3 tons per season. There are no farms wholly on this soil. Farmers devote this soil to corn and cotton and grow kafir, oats, and wheat on the upland soils. Land of the Osage silt loam is valued at about $40 an acre.

In the following table are given the results of mechanical analyses of samples of the soil and subsoil of the Osage silt loam:

Mechanical analyses of Osage silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
450745	Soil	0.1	0.2	0.2	1.8	17.7	63.6	16.4
450746	Subsoil	.0	.2	.4	9.8	26.2	42.1	21.2

SUMMARY.

Payne County is situated in the north-central part of Oklahoma. It has an area of 695 square miles, or 444,800 acres. The topography varies from level to gently undulating, and in the western and eastern parts to rolling. Practically all parts of the county are well drained by the Cimarron River and its tributaries.

In 1910 the total population of the county was 23,735, of which 85.5 per cent was rural. Stillwater, Cushing, and Yale are the most important towns. Transportation facilities are good, no part of the county being more than 8 or 9 miles from a shipping point. The county roads are usually in fair condition and in some cases are very good. Rural mail delivery service and telephones are in reach of nearly every farm. The most important outside markets are Oklahoma City and Kansas City.

The climate is characterized by rather long, hot summers and generally mild winters. The mean annual temperature is 59.1° F. The average annual rainfall is 33.83 inches. The greater part of the

rainfall comes during the growing season, but the precipitation in many years is not favorably distributed, and crops may suffer from drought for long periods during the summer.

The principal crops are corn, cotton, kafir, hay and forage crops, oats, wheat, and alfalfa. The raising of live stock, largely beef cattle, horses, and mules, is carried on in some parts of the county, and some hogs are raised on nearly every farm. No systematic crop rotation is practiced, and very little fertilizer is used.

The greater part of the upland soils are residual from sandstone and shales, which vary from red to brown in color and give rise to similarly colored surface soils. The red or Vernon soils occur chiefly in the western and central parts of the county, while the brown-colored or Bates and Kirkland soils occupy the eastern and central parts of the county. One type of upland soil occurring in the eastern part of the county is derived from lime-stone, and is classed in the Summit series. The upland soils vary from nearly level to rolling. The more rolling soils are more sandy and have more friable subsoils than the flatter soils. The upland soils are devoted chiefly to kafir, oats, cotton, and wheat, and are used for the production of prairie hay and the grazing of cattle. The sandy upland soils are generally timbered with small oak.

The upland soils that are not residual are classed in the Knox and Derby series. These soils are of eolian origin, and sandy in texture. The Derby soil is more productive than the Knox.

The terrace soils of the county occur mostly along the Cimarron River. They are generally very productive, being especially adapted to alfalfa, and constitute some of the highest-priced lands of the county. The first-bottom soils consist mostly of material washed from the upland soils of the Permian Red Beds region. The alluvial soils in the Cimarron River bottoms are more or less calcareous, while those in the creek bottoms are generally neutral. The greater part of the bottom land is cultivated. The yields of the various crops are among the highest obtained in the county.

[PUBLIC RESOLUTION—No. 9.]

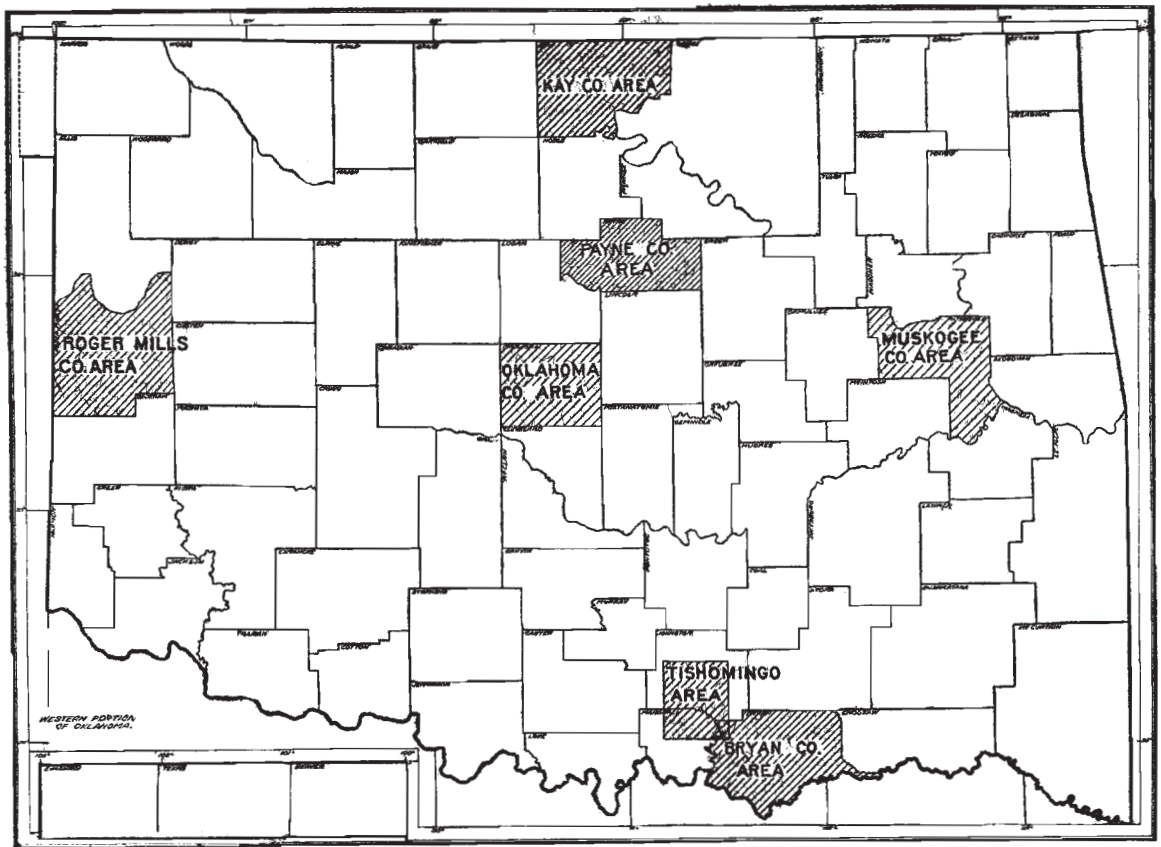
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Areas surveyed in Oklahoma.

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