Issued June 27, 1914.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE KANSAS STATE AGRICULTURAL COLLEGE, H. J. WATERS, PRESIDENT; KANSAS AGRICULTURAL EXPERIMENT STATION, E. H. WEBSTER, DIRECTOR; W. M. JARDINE, AGRONOMIST.

SOIL SURVEY OF CHEROKEE COUNTY, KANSAS.

BY

PERCY O. WOOD, OF THE U. S. DEPARTMENT OF AGRICULTURE, AND R. I. THROCKMORTON, OF THE KANSAS STATE AGRICULTURAL COLLEGE.

HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1912.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1914.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., November 29, 1913.

SIR: The accompanying report and soil map cover the survey of Cherokee County, Kans., one of the projects undertaken by the bureau during the field season of 1912. This work was carried on in cooperation with the Kansas State Agricultural College and Experiment Station, and the selection of this area was made after conference with State officials.

I recommend that the report and map covering this work be published as advance sheets of Field Operations of the Bureau of Soils for 1912, as provided by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

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

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SOIL SURVEY OF CHEROKEE COUNTY, KANSAS.

By PERCY O. WOOD, of the U. S. Department of Agriculture, and R. I. THROCKMORTON, of the Kansas State Agricultural College.

DESCRIPTION OF THE AREA.

Cherokee County is situated in the extreme southeastern corner of the State of Kansas. It is bounded on the east by Jasper County, Mo., on the south by Ottawa County, Okla., on the west by Labette County, and on the north by Crawford County, Kans. It forms an almost perfect square, being slightly over 25 miles from east to west

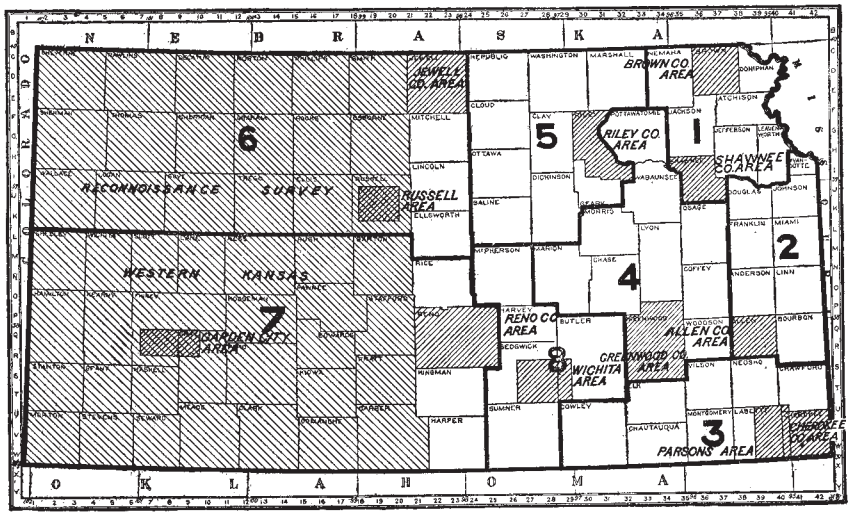

FIG. 1.—Sketch map showing areas surveyed in Kansas.

and 23¼ miles from north to south. The county comprises 585 square miles, or 374,400 acres.

While it consists mainly of residual prairie country, Cherokee County includes the western extension of the Ozark uplift, which constitutes the southeastern part of the county, comprising an area of only about 35 square miles. There is a general range in elevation from about 780 feet to something over 1,100 feet above sea level. An elevation of 890 feet at Columbus has been definitely established. Most of the upland part of the county consists of undulating to gently rolling prairie, with an average elevation of 850 to 900 feet. There are occasional ridges and hillocks. The stream bottoms and terraces

are generally level. In general the county consists of a broad plain with broad, shallow, flat-bottomed valleys along the larger streams.

The county includes two drainage divisions, which are comparable in size. They are separated by a divide which is most prominent from near the Oklahoma line to Columbus. The western part of the county is drained by the Neosho River and the eastern part by Spring River. The Neosho River enters the county at about the center of the west county line and, following a meandering course, leaves it at a point about 4 miles east of the southwest corner. Its principal tributaries are Lightning, Deer, Cherry, and Fly Creeks. These streams flow in a southwest direction, and, with Tarr and Fourmile Creeks, which head about 5 miles from the Oklahoma line and flow south, drain the entire western half of the county. Spring River enters the county at a point about 3 miles north of the center of the east county line, and leaves it about 5 miles west of the southeast corner. With its principal tributaries—Cow, Shawnee, Brush, and Willow Creeks from the west, and Short, Shoal, and Killaboo Creeks from the east—this stream drains the eastern half of the county. The main tributaries of Spring River from the west flow in a southeast direction. The large creeks radiate from the center of the county, and the two rivers converge toward the center, uniting a few miles south of the State line, eventually flowing through the Arkansas River into the Mississippi. All but the largest streams are dry most of the summer. Spring River is fed by springs in the limestone hills of the Ozarks, and the water is practically always clear. The Neosho heads in and flows through prairie country, and is usually muddy, with soft bottom and banks. It has a very low gradient of only about 1.09 feet per mile, and this, with its winding channel and the immense volume of water it often receives, causes frequent floods. Nearly two-thirds of Neosho Township and about a third of Lola Township are subject to overflow. In Spring River also overflows are frequent but do not cover nearly as much territory as those of the Neosho. The larger creeks have comparatively wide bottoms, and these, as well as the river bottoms, are inundated after heavy rains.

The land forming Cherokee and Crawford Counties was originally the property of the Cherokee Indians. White settlers entered the region as early as 1835. Owing to unsettled conditions, however, permanent settlement and improvement did not begin until 1872. Cherokee County was first known as McGee County, the name being changed in 1860. The county was not organized, however, until 1866.

The first settlers were mainly from the northern and central States, the majority from Indiana and Illinois, and many from Pennsylvania, New York, and Ohio. They were generally without capital and

dependent on their own efforts and the natural resources of the country for a living, many of them deriving an income from hunting and trading with the Indians. By about 1872 agriculture had become important, and for a number of years this was the leading industry.

In 1877 coal was discovered and mined at Scammon, and from that time to the present coal mining has steadily increased. Cherokee County and Crawford County produce the great bulk of the coal mined in the State. The present coal workings in Cherokee County are situated in the north-central part in a region extending from a point a short distance north of Columbus in a fan-shaped area with a width of about 13 miles along the north county line. Rich deposits of zinc and lead were discovered near Galena in 1877. Since that time the mining of these minerals has had a remarkable growth. The locality where these minerals are found is confined to the Spring River district, extending for a distance of about 15 miles from the southeast corner of the county north along the State line to the vicinity of Lawton and for only a short distance west of Spring River. The richest workings are found in the bottoms of Spring River and the valleys of its principal tributary streams from the east and their contiguous draws. This section forms part of the Joplin district, which is the richest zinc-producing region of the United States. All the lead and zinc mined in Kansas are produced in this corner of Cherokee County.

The coal and zinc industries create a large nonagricultural population, and are responsible for the building and development of a number of small towns and villages. These industries have a stimulating effect on agriculture, as they furnish a large local market especially favorable to the development of specialized agriculture, such as truck growing, fruit growing, and poultry raising.

According to the 1890 census, the population of Cherokee County was 27,770. In 1900 it had increased to 42,694, and in 1910 it is given as 38,162. Even during this decade there was an increase of 5 per cent in the rural population. This was more than offset by a decrease of 10.6 per cent in urban population, due largely to abnormal conditions in Galena. The population is again steadily increasing. There is a large foreign-born element, most of the European countries being well represented.

Columbus, with a population of 3,064, is the present county seat, although Galena, with a population of 6,096, is the largest town in the county. It is in the lead and zinc country and is entirely dependent on lead mining for its existence. The principal towns of the coal district are Weir and Scammon, each of which has a population of something over 2,200; Mineral, with a population of about 1,770; and Corona, with about 1,000 inhabitants. Roseland, Mackie,

Stippville, and Turck are typical small mining towns, and Crestline, Neutral, Melrose, Faulkner, Hallowell, and Sherwin Junction are small agricultural villages. Baxter Springs, with a present population of 1,598, was at one time a close rival of Columbus for the county seat and was one of the most important towns in the southwest.

The first railroad transportation in the county was furnished by the Kansas City, Fort Scott & Gulf Railroad, which was completed from Kansas City to Columbus in 1870, and soon afterwards extended to Baxter Springs and Galena, and to Joplin, Mo. The St. Louis & San Francisco Railroad later acquired this road, and built another line from east to west across the center of the county in 1876. In 1886 and 1887 a branch of the Missouri Pacific was constructed through the county, running in a northeast-southwest direction from Cherokee, Crawford County, to Chetopa, Labette County. In 1894 a branch of the Missouri, Kansas & Texas Railway was built from Parsons to Mineral, and in 1901 this was completed through Columbus and Galena to Joplin. The Kansas City Southern Railroad traverses about 3 miles of the northeastern corner of the county, and a branch of the Frisco touches the same corner. A new line, the Missouri, Oklahoma & Gulf Railroad, which will practically parallel the Frisco from Galena south through Baxter Springs, is now being constructed.

In addition to the excellent railroad facilities, the county has good interurban trolley service. The Joplin & Pittsburg Railway Co. operates half-hourly cars from Columbus north to Pittsburg, Crawford County, and beyond, and hourly cars on a branch line from Scammon to Mineral, which line is to be extended to Parsons. A line from Pittsburg to Joplin parallels the Kansas City Southern track in the northeastern corner of the county. Galena is the western terminus of the Southwest Missouri Electric Co.'s line, which runs to Carthage, Mo., via Joplin.

The county highways are in only fair condition. In general, there is considerable room for improvement. A few miles of sample road have been constructed to demonstrate that excellent roads can be built and maintained by grading and ditching, without using any other material than the local soil. Many miles of road in and near the zinc district have been greatly improved by a top dressing of "chats" or fine limestone chips from the zinc mines. This material, when packed by rollers or by ordinary travel, makes good roads. The main bridges are kept in fair repair, but many of the culverts and small bridges are in poor condition.

The school facilities of Cherokee County are excellent. All of the towns have one or more good schools, Columbus having five, including a county high school, and Galena four. In addition there are over a hundred country schools distributed throughout the county.

The local markets for the agricultural products of Cherokee County are good, and in addition to these the county is in direct communication with Kansas City and with St. Louis.

CLIMATE.

The climate of Cherokee County is not typical of Kansas nor of any of the four States which practically meet at the southeastern corner of the county. Situated in the extreme southeast corner of the State, it has the greatest amount of rainfall and probably the longest growing season of any county in Kansas. The mean temperatures for the different seasons, as given in the accompanying table, indicate that the average winter is mild, and that the average summer is not excessively hot. The temperatures from which these averages are derived vary greatly. The lowest temperature recorded in the winter season, 28° below zero, and the highest winter temperature, 80° above, both occurring in February, give a range of 108° for the winter season. A range of 88° for the spring season, of 63° for the summer season, and 103° for the fall season show the lack of uniformity that may be expected. The lowest temperature recorded, 28° below zero, and the highest recorded, 110°, give an absolute range of 138°.

Light falls of snow are common in the winter, but they are usually of short duration. Outdoor work can usually be carried on throughout the winter with but few interruptions.

Like those of temperature, the records of precipitation vary greatly. The average annual precipitation of 45.12 inches is higher than that of any other county in the State. The total precipitation for the wettest year is 58.30 inches and for the driest year is 29.62 inches. It is interesting to note that the records for the wettest year show that some of the driest months occurred in that year. The means for the seasons, however, show that the precipitation is fairly well distributed throughout the year, and that over half of the total occurs in the spring and summer, during the growing season. In spite of the fact that the seasonal means show that the greatest amount of precipitation occurs in the summer season, being 15.50 inches, or over a third of the annual total, periods of drought are by no means uncommon, and crops frequently suffer from lack of moisture.

Records at Columbus covering a period of 16 years show the average date of the last killing frost in the spring to be April 6, and the average date of the first killing frost in the fall to be October 22, giving an average growing season of 198 days.

The table following gives the normal monthly, seasonal, and annual temperature and precipitation as recorded at the Weather Bureau station at Columbus for a period of 18 years, 1891 to 1908, inclusive.

Normal monthly, seasonal, and annual temperature and precipitation at Columbus, Cherokee County, Kans.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
December	35.8	78	− 9	2.37	2.01	10.50	4.3
January	33.1	73	−16	1.95	1.10	1.23	4.3
February	33.0	80	−28	2.15	1.90	0.13	3.9
Winter	34.0			6.47	5.01	11.86	12.5
March	46.1	90	6	3.47	1.70	1.97	1.2
April	56.5	91	20	4.08	4.43	0.50	0.3
May	65.9	94	29	6.34	4.05	4.10	
Spring	56.2			13.89	10.18	6.57	1.5
June	74.1	99	44	6.30	4.25	8.67	
July	77.8	110	52	5.21	3.15	11.03	
August	77.4	104	41	3.99	2.19	5.54	
Summer	76.4			15.50	9.59	25.24	
September	71.0	107	32	3.90	0.41	10.12	
October	58.9	99	24	3.03	1.47	0.32	0.1
November	45.5	87	4	2.33	2.96	4.19	1.0
Fall	58.5			9.26	4.84	14.63	1.1
Year	56.3	110	−28	45.12	29.62	58.30	15.1

AGRICULTURE.

Agriculture was the primary object of the early settlers of Cherokee County. The great stretches of rolling prairie, with trees only in the bottoms and along the creeks, encouraged the development of agriculture, and until 1877 it was the only industry engaged in. With the discovery of coal and lead and zinc, agriculture ceased to be the dominant factor except in certain parts of the region. The land in many instances is held at comparatively high prices because of the known or supposed presence of mineral deposits; and many farms, among them some of the best in the county, are owned by mining companies and leased to tenants with the reservation of the right to begin mining operations at any time. The fact that many farmers know and many more suppose that they have mineral on their land, and that the mineral will some day yield them a good income, leads them to take less interest in the permanent improvement of their farms and in the diversification of crops than if they expected always to depend solely on farming. The relative importance of the three leading industries of the county, based on the value of the total

products, is shown by the following: In 1911, the last year for which figures are available, the value of the coal mined in Cherokee County was $2,956,171. The value of the lead and zinc mined in the same year was $1,428,318, giving a total mineral output valued at $4,384,489. The total value of agricultural products for the year 1899, as given by the 1900 census, was $1,470,753, and the value of all crops for the year 1909, as given in the 1910 census, was $1,939,206.

Broadly, the agriculture of the county consists mainly of general farming, with corn, wheat, and hay the leading crops, the greater part of the surplus of these being sold. Corn and wheat have been the principal crops of the county since its earliest settlement. Early in the history of the county cotton was produced in small quantities for a few years, but owing to the uncertainty of the seasons and labor difficulties cotton growing was soon discontinued. Flax for a time was a profitable crop, but a decline in yield due largely to the disease known as flax wilt and to lack of proper rotation caused the virtual abandonment of this crop. Kafir, milo, cowpeas, millet, and alfalfa were introduced in later years, but never became important. Sweet potatoes are grown to some extent, but the acreage is not nearly as large as the climate and adaptability of certain soils to this crop would seem to warrant.

The central, south-central, northeastern, and entire western parts of the county are the agricultural sections, with the northeastern and northwestern townships, Pleasant View and Sheridan, leading. The following table, compiled from the 1910 census, gives the acreage, total production, and average yields of practically all the crops grown in Cherokee County in 1909:

Crop.	Acres.	Total production.	Average yield.
		Bushels.	*Bushels.*
Corn	89,107	1,869,552	20.9
Wheat	24,270	344,398	14.2
Oats	10,315	281,827	28.3
Kafir and milo	941	9,480	10.0
Potatoes	722	56,651	78.4
Barley	302	4,821	16.0
		Pounds.	*Pounds.*
Broom corn	31	11,000	358.0
Hay and forage:		*Tons.*	*Tons.*
Wild or prairie	29,921	33,462	1.12
Timothy	3,021	3,013	.99
Timothy and clover	2,975	3,750	1.29
Millet	893	1,500	1.68
Alfalfa	97	237	2.44

Corn and winter wheat are the staple crops, together with wild or prairie hay. The wheat, as a rule, is stacked in the field, and as soon as thrashed it is hauled to the railroad. In many cases where wheat

is the money crop no rotation is practiced. In some instances wheat has been grown continuously on the same field for over 20 years, and sometimes continuously since the sod was first broken. Wheat growers commonly apply from 80 to 150 pounds of some form of bone-meal fertilizer per acre, and it is a common opinion that such applications materially increase the yields. Winter wheat is usually grown, some of the favorite varieties being the Red Curl, Golden Straw, and German Amber. Where a rotation is practiced it commonly consists of corn, followed by oats, and then wheat for several years, returning to corn. Few cattle are fed, it being more common to sell the grain. Comparatively little clover is grown, except on the limestone soils of the northwest corner of the county. Little grass is sown, most of the hay being cut from the prairies.

Grain and hay are the money crops of the county. Kafir is being more widely grown, particularly on the sandy loams, as this crop withstands drought better than Indian corn, and makes excellent feed. Several small broom factories afford a market for the broom corn grown. Owing to the labor involved this crop is not produced extensively.

The production of alfalfa is largely confined to the front lands and lighter soils along the Neosho and its larger tributaries, although it has proved successful on typical upland soils, where, however, inoculation, lime, barnyard manure, and tile drains were important factors, none of which seems necessary in the bottoms. In the bottoms, however, the success of alfalfa without lime, inoculation, or artificial drains is more than offset by the uncertainty of the crop, due to overflows.

Dairying is practiced on only a small scale, but is being extended. Usually the cream only is sold, the butter factory at Columbus, through its substations, being the principal market. Silos are being built, largely of concrete.

In the aggregate the raising of horses and mules is quite an important industry in Cherokee County. Though the individual herds are not large, nearly every farmer raises a few. The 1910 census reports 11,142 horses with a value of $1,013,587, and 2,455 mules, with a value of $269,094, in the county. The raising of beef cattle is not common, and hogs and sheep are not raised to any great extent.

Japan clover, or lespedeza, grows wild on many of the soils of the county, particularly in the southeastern and eastern sections. No attempt seems to have been made toward its cultivation, and its value as a pasture and forage plant is evidently not appreciated. Lespedeza is a leguminous plant, naturally adapted to acid soils.

Field tests indicate that the soils of Cherokee County, almost without exception, are acid, and the type of agriculture commonly practiced tends to aggravate this condition, while no attempt at correction is made. The soils consist largely of silt loams with

heavy subsoils, and this combination naturally causes unfavorable drainage conditions. Another cause of poor drainage is the absence or low content of organic matter, resulting from constant grain growing with no adequate return to the soil. The majority of wheat growers burn the straw, and the manure produced is but a fraction of what should be applied. As a rule the soil is completely saturated in times of heavy rainfall and retains but little moisture for use during periods of drought, so that the growing crop is subjected to a series of unfavorable conditions which result in diminished yields. Practically all of the soils in the county are in need of lime, to correct acidity, the incorporation of organic matter, both in the form of manure and by turning under instead of burning the straw, to improve the physical condition and to increase the water-holding capacity of the soil, deeper plowing, improvement of drainage, rational and systematic rotations, and a consistent practice of seed selection.

The raising of small fruits is becoming an important industry in the vicinity of Columbus. Strawberries and various bush berries are being grown in increasing quantities. Nearly every farm has a few fruit trees, but large orchards are rare. There are but two or three commercial orchards in the county.

Modern machinery is quite commonly used throughout the county. Improved riding plows and cultivators, up-to-date drills and binders, and gasoline hay presses are displacing the less efficient machinery formerly in use. In many cases the farm machinery is neglected, owing to the lack of adequate farm buildings.

According to the census of 1910 there are 2,721 farms in Cherokee County, having an average size of 118.6 acres, with an average of 105.3 acres improved. Of the land in the county 83.3 per cent is in farms and 88.8 per cent of the farm land is improved. Of the farms 53.1 per cent are operated by the owners, and of those operated by tenants 581 are held under the share system, 371 are rented for cash, and 256 for both shares and cash.

Farm labor is comparatively plentiful through haying and harvesting times, when under the system of farming commonly practiced such labor is most needed. Many men employed as helpers and drivers in the mines through the winter work on the farms in the summer, particularly during the busy periods.

SOILS.

Cherokee County comprises large areas of soils topographically well suited to farming. The county lies almost wholly within the Western Prairie region, only the extreme southeast corner extending into the Ozark region. The upland soils are all residual, or formed from the immediately underlying rocks, which, with the exception of the cherty limestone of the Ozark section, belong to the Pennsylvanian

division of the Carboniferous and consist of interbedded shales, sandstones, and limestones, with the shales predominating, sandstones next, and a comparatively small amount of limestones. These rocks are all sedimentary, but their original horizontal position has been altered and they now dip slightly to the northwest. Erosion has accentuated these differences in elevation. The different rocks, different-textured rocks of the same kind, and combinations of the rocks under the process of weathering and erosion have given rise to the various residual soils of the county.

A soil series embraces soils of the same origin and having the same range of color in the surface section with subsoils of about the same general characteristics. Each series includes a number of types, which differ from one another in texture or in relative content of clay, silt, and sand.

The soils of Cherokee County fall into two main groups: (1) upland, or residual soils, and (2) bottomland, or alluvial soils.

In the following table the soils are grouped according to origin:

Group.	Parent rock or material.		Soil type or series.
Residual soils.	Cherty limestone (Ozark)		Clarksville stony loam.
	Prairie limestone		Crawford silt loam.
	Shales, sandstones, and limestones		Summit silt loam.
	Sandstone and arenaceous shales		Bates fine sandy loam.
			Bates very fine sandy loam.
			Bates loam.
			Bates silt loam.
	Shales (light brown to gray)		Cherokee silt loam.
	Shales (dark gray to black)		Oswego clay.
			Oswego silty clay loam.
Alluvial soils.	Terrace soils (second bottoms).	Prairie material (gray to whitish soil).	Neosho silt loam.
		Prairie material (brown soil).	Shawnee silt loam.
		Ozark material, with some prairie material (gray to whitish soil).	Robertsville silt loam.
		Ozark material (brown soil, reddish subsoil, gravel substratum).	Riverton silt loam.
			Riverton silt loam, shallow phase.
			Riverton gravelly loam.
	First bottoms (recent alluvium).	Prairie material (gray to black color).	Osage.
		Ozark and prairie material (light-gray soil).	Holly.
		Ozark and prairie material (brown soil).	Huntington.
		Meadow	

Of the residual soils two series are derived from limestone, the Clarksville, represented by one type, from the cherty limestone of the Ozark region, and the Crawford, from the chert-free limestone of the Great Plains region. Another series, the Summit, represented by but one type in the county, is derived from both shales and limestones of the Great Plains region, while the three remaining upland series, the Bates, Cherokee, and Oswego, are derived from the shales and sandstones of the prairie country. Four types of the Bates, one of the Cherokee, and two of the Oswego series were mapped.

Of the alluvial soils, three series, the Osage, Neosho, and Shawnee, are derived entirely from reworked prairie material. The Osage series, embracing four types, includes first bottom; and the Neosho and Shawnee, with one type each, second bottom or terrace soils. The remaining alluvial soils are derived from materials from both the Limestone Valleys and Uplands province and the Great Plains region. They are of comparatively small extent in the county. The first-bottom soils in this group are the Holly and the Huntington, each represented by one type, and the terrace soils, or second bottoms, are the Robertsville and Riverton, with one and two types, respectively, the silt loam of the latter having a shallow phase.

A geological section of the county would show a series of rocks as follows: Proceeding from the southeast corner of the county these are, first, a flinty or cherty limestone, then sandstone overlain by shale, then a higher sandstone outcropping in the vicinity of Columbus, giving rise to the high, sandy hills extending roughly in the form of the letter S to the east and south of Columbus. Another series of shales, interspersed with thin sandstone beds, is next encountered, and at the top, in the northwest corner of the county, a series of Coal Measure limestone beds, which are not flinty, and which have shales mixed with them.

The relation existing between the soils and this grouping of rocks is plain. The cherty limestone in the southeast corner of the county gives rise to the Clarksville stony loam and partly to the shallow phase of the Riverton silt loam. The formations next occurring, shales over sandstone, give rise largely to the Bates silt loam, and where the shales are less influenced by the underlying sandstone, to Cherokee silt loam. The next formation in the geological section, the sandstone outcropping near Columbus, weathers down into the loam and sandy loams of the Bates series. The location of these comparatively massive sandstones can be plainly traced by the nearly unbroken belt of the Bates loam and fine sandy loam occurring on the east, southeast, and south of Columbus. The next series of shales, with thin sandstone beds, gives origin mainly to the Cherokee silt loam. In the last division of the section, the limestone and shale beds of the northwest corner of the county, the Summit and Crawford silt loams and the Oswego soils are encountered.

The Osage soils, found in the bottoms of practically all the streams rising in or flowing through the prairie soils, attain their best development along the Neosho River and its main tributaries. These soils are subject to frequent and prolonged overflow, but in favorable seasons are very productive. The Osage silt loam is the predominating member of this series, although the Osage clay has rather a large development in the southwest corner of the county.

The Holly silt loam is a light-gray, poorly drained soil occurring in small areas in the Spring River bottoms. The Huntington silt loam is a brown bottom soil found along the same stream. Both of these types are influenced by material from the cherty limestones of the Ozarks, as well as some wash from the prairies. They are both subject to overflow. Of the two, the Huntington is the better drained and the more desirable for agriculture.

The Neosho silt loam is a terrace or second-bottom soil, most of which borders the Neosho River and the lower parts of its main tributaries. It is a light-gray soil, with a stiff, plastic clay subsoil, low in organic matter. The substratum contains chert and limestone material washed from areas farther up the river. It is used mainly for wheat and grass, to which it is best adapted.

The Shawnee silt loam is very similar to the Neosho in origin and relative position, but differs in color of both soil and subsoil. It occurs as a low terrace along Cow Creek.

The Robertsville silt loam occurs on well-developed terraces along Spring River. It is a light-gray soil with a drab plastic clay subsoil resembling that of the Neosho, but derived largely from the cherty limestones of the Ozarks. It is an uncertain soil, being very sensitive to excess of moisture or drought. It is not extensive.

The Riverton series occupies terraces adjoining the Spring River bottoms, and also old high terraces, now much eroded, which occur at a distance of 5 miles from the river in this county. Two types of this series were encountered, the gravelly loam and silt loam, with a shallow phase of the latter. The series is characterized by the brown soil, reddish-brown to red subsoil, and the substratum of cherty material which occurs at varying depths.

The following table gives the name and relative and actual extent of each of the soils of Cherokee County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Bates silt loam	91,584	24.5	Oswego silty clay loam	6,656	1.8
Cherokee silt loam	74,816	20.0	Shawnee silt loam	6,208	1.7
Osage silt loam	30,976	8.3	Clarksville stony loam	4,160	1.1
Osage loam	27,520	7.3	Robertsville silt loam	3,008	.8
Neosho silt loam	27,520	7.3	Riverton gravelly loam	2,624	.7
Bates loam	20,032	5.3	Bates very fine sandy loam	1,664	.4
Summit silt loam	16,384	4.4	Oswego clay	1,664	.4
Riverton silt loam	9,408	4.2	Crawford silt loam	1,472	.4
Shallow phase	6,528		Meadow	1,344	.4
Osage clay	13,632	3.6	Holly silt loam	1,344	.4
Bates fine sandy loam	9,664	2.6			
Huntington silt loam	8,448	2.3	Total	374,400	
Osage silty clay loam	7,744	2.1			

CHEROKEE SILT LOAM.

The Cherokee silt loam, to a depth of 10 to 12 inches, consists of an ashy-gray, floury silt loam. When dry the soil is almost white, but with increasing moisture it becomes much darker in color. The subsoil is a silt loam, nearly white in color, containing slightly more clay, and usually being somewhat more compact than the surface material. In places this subsurface layer is very high in silt, containing but little material of other texture. It varies from 2 to 12 inches in depth, occasionally being absent altogether, but typically it has a depth of 4 to 8 inches. It is often mottled with rusty-brown ferruginous material. Underlying this nearly white subsurface, and beginning abruptly at about 14 to 18 inches, is a tough, plastic, waxy heavy clay, of a dark-drab color, usually mottled with red. With increasing depth, this red mottling usually gives way to yellowish-brown and grayish colors, while the dominant color remains a drab, and the material is consistently a tough plastic clay to a depth of 36 inches and more.

The type has a rather close resemblance to two other soils of the county, the Neosho and Robertsville silt loams, both of which are of alluvial origin, but the Cherokee silt loam is undoubtedly residual from fine-grained shales. It is locally called "white ashy land," owing to its light color and ashy texture, or "hardpan land," because of its tough, impervious subsoil. The deep phase of this type, where the subsoil is encountered at greater depths, is considered the more desirable. In some cases, where the surface and subsurface soils are each of considerable depth, the subsoil may be 2 feet or more from the surface.

The topography is flat to gently undulating. As a whole the type is more nearly level than any other soil in the county, with the exception of those of alluvial origin. It also occurs on long very gentle slopes, where it is an undulating prairie soil, with occasional level areas. Any change in elevation from that normal to any given area of this type is accompanied by a difference in the soil. Usually a change to a slightly higher position means the passing into a different soil type, usually the Bates silt loam. The type usually adjoins the more rolling Bates soils, but also grades, often almost imperceptibly, into the Neosho silt loam. Sometimes level areas of the Cherokee silt loam are surrounded by soils of more rolling topography, thus giving the type a basinlike appearance.

The Cherokee silt loam is an important soil in Cherokee County, and this is the first place in which this series has been mapped. It is known to occur, however, over a much larger area in southeastern Kansas, southwestern Missouri, and northeastern Oklahoma. The type has

its main development in the center of the county. Smaller areas are encountered in every township, with the exception of Garden. Its area in Lowell Township is very small.

The Cherokee silt loam is derived from the disintegration of argillaceous shales. Where influenced by other rocks, for instance, the fine-grained sandstones, soils of other series, such as the Bates, are formed.

There is a small development of the Cherokee silt loam near the common corner of Pleasant View, Mineral, Crawford, and Shawnee Townships, which if of sufficient extent would have been mapped as a phase of the main type. In its main characteristics this local variation corresponds with the typical soils, being similar in color and texture of the surface and subsurface soil and in denseness and plasticity of the subsoil. It differs only in the color of the subsoil, which is brown rather than drab.

Drainage is one of the great problems connected with the type. Its level to very gently sloping topography, the lack of organic matter, and the tough, dense, almost impervious subsoil combine to produce unfavorable drainage conditions, which can be best corrected by the installation of tile drains.

The Cherokee silt loam is a typical prairie soil, and in its natural state supports a good growth of the various wild prairie grasses and weeds. It is largely used for the production of prairie hay, of which 1 ton to the acre is the average yield. The next important crop grown is wheat. The yield varies considerably, but averages about 15 bushels per acre. Oats should do well, but the crop is uncertain, largely because of unfavorable moisture conditions. Only poor to fair yields of corn and kafir are secured. The type is not naturally as well suited to corn as to grass and wheat.

The Cherokee silt loam is in need of lime, organic matter, and drainage, and until these are supplied, at least in part, the present low yields will continue. Tiling is the best means of remedying present drainage conditions. Following the establishment of good drainage, heavy applications of lime should be added to correct the acidity and improve the physical condition of the soil. Alfalfa and red clover may then be grown profitably, and with a judicious rotation, including some crop to furnish organic matter, preferably a legume, a permanent improvement in this soil will result.

Typical areas of the Cherokee silt loam can be purchased for $25 to $60 an acre, depending largely on location.

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

Mechanical analyses of Cherokee 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.*
381303	Soil	0.3	0.7	0.9	1.9	8.2	84.3	4.4
381304	Subsoil	.8	1.4	.4	1.4	8.1	81.2	6.6
381305	Lower subsoil	.0	.0	.2	.5	3.2	46.9	49.1

OSWEGO CLAY.

The soil of the Oswego clay to a depth of 16 to 20 inches is a black, heavy, plastic clay, grading into a dark yellowish brown, sticky, plastic clay, which in the lower portion contains some black oxide of iron material. Occasionally the lower subsoil, from about 30 to 36 inches, contains large quantities of gypsum crystals, and in other localities limestone fragments are found at about 26 to 28 inches, becoming more numerous with increasing depth. The type lies below the Summit silt loam and Oswego silty clay loam, and occupies level to very gently sloping areas usually adjoining streams and draws.

The Oswego clay is practically confined to the northwestern corner of the county, in the region of the dark-colored calcareous shales and thin-bedded Carboniferous limestones. In origin it is residual from these rocks. The influence of the shales, however, greatly outweighs that of the limestone. The soil usually contains very little lime, and in many places has an acid reaction. It is locally known as "black limestone land."

The heavy, dense character of both soil and subsoil prevents or greatly retards percolation of water, and with the level topography causes poor drainage. Tile drains are necessary for the effective utilization of this soil, and the drainage would be greatly aided by heavy applications of lime, which tends to flocculate the minute soil particles, thus promoting a more rapid and easy movement of water. Such treatment not only aids percolation and the removal of surplus surface water, but also greatly improves moisture conditions in times of drought by allowing and aiding an upward movement of water from the deep subsoil. This upward movement of water, effected by capillarity, also brings up plant food from the subsoil, ordinarily unavailable to most plants.

Fairly good yields of the ordinary farm crops are secured on the Oswego clay. Corn ordinarily yields 30 to 45 bushels, wheat 15 to 20 bushels, and oats 30 to 40 bushels per acre. Three cuttings of alfalfa are made, with an average yield of about 1 ton each. It is rather difficult to obtain a good stand of alfalfa on this soil, because

of heaving and freezing out, due to its dense structure and the large amount of water it retains. Much of the type is in pasture and mowings, because of the difficulty experienced in plowing and cultivating. Great care is required in these operations with respect to moisture conditions. If plowed when too wet the soil forms clods which can only be broken with difficulty, and is practically worthless until the following year. When thoroughly dry it cracks badly.

OSWEGO SILTY CLAY LOAM.

The Oswego silty clay loam consists of a dark-brown to black silty clay loam, which has a depth of 16 to 18 inches, and is underlain by a dark-brown to black, stiff, tenacious clay. The subsoil is generally mottled with yellow or rusty brown. It is characterized by the presence of calcareous and ferruginous concretionary material, and in typical situations by fragments of limestone.

This soil occurs in small areas and as bands on gently sloping to nearly level areas bordering small streams and drainage ways. It lies below the ridges and slopes occupied by the Summit silt loam and Bates silt loam, in positions similar to that of the Oswego clay, which it closely resembles. Its most extensive development is in the northwestern part, but it is also found bordering small stream courses over a large part of the county. In typical areas in Sheridan Township the soil is nearly black in color. A slightly lighter phase is found in places, as in the areas about a mile and a half south of Neutral, in section 20 of Spring Valley Township, in the vicinity of Scammon, and in section 30 of Sheridan Township. This variation has a dark-grayish to grayish-brown surface soil, but in other respects it is similar to the main development of the type.

The Oswego silty clay loam is residual from dark-colored shales which in some places, particularly in and near Sheridan Township, contain calcareous material or very thin-bedded limestone. Even in such situations the resulting soil is but little influenced by the calcareous material, except in the deep subsoil where limestone fragments may occur. Like the Oswego clay, it is locally known as "black limestone land," from its dark to black color, and the occasional presence of calcareous fragments in the lower part of the section and on eroded spots, such as stream banks.

Owing to the flat to very gently sloping surface, the heavy soil, and the almost impervious subsoil, the natural drainage is poor. The soil cracks badly when dry and is subject to heaving in winter. When plowed too wet, large clods form. The type is difficult to cultivate. While slightly easier to handle than the Oswego clay, the same practices suggested for the improvement of that soil apply to the silty clay loam.

Much of this type is in permanent pasture, to which in its present condition it is best adapted. All the ordinary farm crops

of the region, however, are grown on it to some extent, the slightly lighter phase especially being under cultivation. Corn produces 30 to 40 bushels, wheat 18 to 22 bushels, oats 30 to 35 bushels, and prairie hay about 1 ton per acre. Three cuttings of alfalfa are usually made, with a total yield of 2½ to 3 tons of hay. Alfalfa grows without inoculation or lime, but artificial drainage is essential to prevent serious damage from heaving and freezing in the winter and early spring. The Oswego soils of this county have not been handled with sufficient regard for the problems incident to such heavy soils. With the improvement of drainage, the application of lime, and the occasional turning under of a green crop, to improve the internal water movement and the water-holding power and general tilth of these soils, they will prove to be among the strongest and most productive and desirable of the county.

BATES SILT LOAM.

The soil of the Bates silt loam, to a depth of about 10 inches, is a grayish-brown to brown silt loam. It does not have the floury feel characteristic of the Cherokee silt loam. This is doubtless due to a slightly higher content of organic matter and very fine sand. The surface soil is underlain by a grayish-brown, brown, or yellowish-brown silt loam to friable silty clay loam, which extends to a depth of about 18 inches, where it changes to a yellowish-brown silty clay, usually mottled with red. Sometimes this red mottling continues through the remainder of the 3-foot section, but it usually gives way to gray or drab, the lower subsoil in such cases being a mottled yellowish-gray and drab silty clay. This subsoil is not plastic and waxy like that of the Cherokee and Oswego soils, but is rather friable or brittle. When thoroughly dry, however, it is quite hard.

The Bates silt loam is the most extensively developed upland soil of the county. It occupies the slopes and crests of low ridges, the topography being undulating to gently rolling. It is a typical prairie soil, both in topography and vegetation, and is found in all the prairie sections of the county, with its greatest development in the northern townships, including Ross, Mineral, Cherokee, and Pleasant View, and in the section between Baxter Springs and Columbus. Over the remainder of the prairie country it occurs in smaller bodies, being closely associated with the Cherokee silt loam, occurring both above and below this soil, and almost invariably occupying the slopes bordering the streams and draws, even when these occur in large areas of the Cherokee soil.

The Bates silt loam is residual from soft shale, with some minor influence from fine-grained soft sandstones. Small shale fragments are often present in the subsoil, and on the surface of slopes where the soil covering is thin.

The mellow surface soil, rather friable subsoil, and generally rolling topography produce fair natural drainage over this type. Some areas which adjoin or are lower than bodies of the Cherokee silt loam are kept in a more or less saturated condition from seepage water, but these areas, which are usually of small extent, could easily be improved.

The Bates silt loam is generally considered a desirable farming soil. It is more easily handled than the Cherokee or Oswego soils, can be kept in better physical condition, and is better drained, warmer, and earlier. Its subsoil is heavy enough to hold fertilizers without leaching. It is commonly used as a corn and potato soil, where a choice can be made, wheat and grass being more commonly grown on the Cherokee silt loam where bodies of both soils occur on the same farm. The ordinary yield of corn is about 30 bushels; of wheat, 15 to 18 bushels; oats, 30 bushels; and prairie hay, 1 ton per acre. Some kafir and cowpeas are grown. The latter crop should be grown more extensively.

This type has a value of $25 to $60 an acre, depending largely on improvements and location.

BATES LOAM.

The Bates loam is closely associated with both the silt loam and the fine sandy loam of the same series, and is a variable type both in color and texture. To a depth of about 6 to 8 inches the soil consists of a grayish-brown to brown loam to silty loam, the color becoming much darker with increase of moisture content. The texture may vary from a light loam to a silty loam over small areas. The surface material typically grades through a yellowish-brown friable loam into a friable fine sandy clay loam or fine sandy clay at about 14 to 18 inches. The subsoil is often mottled with bright yellow and red. In places it grades into a buff silty clay, carrying large quantities of fine sand. Rock is usually encountered at 15 to 30 inches; it is almost always found within the 3-foot section, the soil being shallowest on the slopes.

The type is residual from sandstones and arenaceous shales. It is often found as an intermediate type between the higher lying fine sandy loam and the lower lying silt loam of the Bates series. Where the underlying rock is near the surface, numerous small fragments and chips of shale and sandstone are found scattered over the surface and throughout the soil, particularly in the subsurface and subsoil. On the slopes larger rock fragments are often distributed over the surface.

The Bates loam has a rolling topography. It occupies the crests of rather wide ridges and the slopes bordering higher areas of the fine sandy loam. The loose, open structure and the rolling

topography render the drainage good, and the soil is mellow and easily worked. Owing to the open character of the soil and to the fact that the underlying rock occurs at shallow depths, the type is rather susceptible to drought, and for this reason deeper plowing should be practiced and the supply of organic matter increased by the application of stable manure and the plowing under of green crops.

The type is used for general farm crops, and yields are fair in favorable seasons, but low in seasons of scant rainfall. For this reason kafir is a favorite crop.

BATES FINE SANDY LOAM.

The soil of the Bates fine sandy loam consists of a grayish-brown to brown or reddish-brown fine sandy loam to a depth of 6 to 14 inches. This grades through lighter colored material of about the same texture into a fine sandy clay loam to fine sandy clay at 10 to 16 inches. The subsoil, while compact, is friable, and usually the sand content increases with depth until bedrock is encountered. The subsoil is mottled with red, yellow, and yellowish brown, the colors becoming more intense with depth. A stratum of yellow, red, and brown sandy material, which is really rotten rock, often immediately overlies the rock. The bedrock is encountered at depths varying from 10 to 30 inches, depending largely on the slope. Chips and fragments of the parent rock are frequently present in the subsoil, and are sometimes found in the upper part of the soil section and on the surface.

The type is residual from the fine-grained sandstones which outcrop at various places in the county and to some extent from arenaceous shales. These rocks, although not of great hardness, have resisted weathering more than the surrounding shales, and the resulting topography is rolling to ridgy or hillocky. A chain of these stony hillocks extends in the form of the letter S to the southeast and south of Columbus, the resulting soils being largely the Bates fine sandy loam. In other parts of the county their occurrence is confined to small, isolated areas. The fine sandy loam usually occupies the higher ridges and steeper slopes. The soil on the steeper slopes usually has a high content of rock fragments of varying sizes, often to such an extent as to interfere with cultivation. Such areas are generally left in pasture. Small moundlike elevations or knolls, which usually consist of the fine sandy loam, are often encountered in areas of the Bates loam, and similar knolls, composed of the loam, often occur in the Bates silt loam. Such minor elevations are very often utilized for house and barn lots, being well adapted for such purposes, owing to their better drainage.

Owing to the loose structure, comparatively coarse texture, and rolling to hilly topography of the type, the drainage is good to excessive.

Unplowed areas and the steeper slopes sometimes support a sparse growth of sumac, and in a few places a fair growth of oaks. Such areas are thin and stony, and their best utilization is for pasture and woodlots. The greater part of the type is natural prairie.

Fair yields of the ordinary farm crops are obtained in seasons of plentiful and frequent rainfall, but crops suffer during dry periods. Kafir is grown on the fine sandy loam and loam more than on the other soils because of its greater resistance to drought. In some sections the fine sandy loam is called sweet-potato land, but comparatively little advantage is taken of this natural adaptation. It is also suited to melons and truck crops. The type should be given special treatment and utilized for special crops rather than for general farming. It is low in organic matter and is in need of lime.

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

Mechanical analyses of Bates 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.*
381335	Soil	1.4	0.9	0.8	23.9	32.5	25.8	8.9
381336	Subsoil	.6	.9	1.0	30.9	25.3	24.6	16.7

BATES VERY FINE SANDY LOAM.

The surface soil of the Bates very fine sandy loam consists of a grayish-brown to brown very fine sandy loam to a depth of about 8 to 10 inches. The subsoil is a light-brown to yellowish-brown fine sandy clay which at about 20 to 24 inches becomes lighter in color and mottled with brown, gray, red, and yellow. The subsoil is quite heavy and compact in spite of its content of fine and very fine sand.

The type is residual from arenaceous shale and very fine grained sandstone. The underlying rock is encountered at 3 to 10 feet, the soil being shallowest on the slopes. The rock is often exposed where small draws and drainage ways have become established. The rock lies deeper than in the Bates loam and fine sandy loam. No rock fragments are found on the surface or in the soil.

The type occurs in small areas on the slopes and crests of rounded ridges, and lies above the adjoining soils. The topography is gently rolling.

In spite of the rolling surface and sandy soil the drainage of the type is somewhat deficient, owing to the compact nature of the subsoil.

The surface soil often remains saturated for some time after heavy rains. The organic-matter content is low, and the soil is in need of lime.

This type is used for general farm crops and for fruit, and good results are obtained. Wheat yields an average of 20 bushels, corn 40 bushels, oats 35 bushels, and potatoes 100 bushels per acre. Sweet potatoes do well, especially when applications of lime and manure are made. The type has a value of about $50 an acre.

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

Mechanical analyses of Bates 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.*
381323	Soil	0.0	0.5	0.6	23.2	28.0	40.6	7.4
381324	Subsoil	.0	.5	.4	23.5	28.3	31.0	16.5

SUMMIT SILT LOAM.

The soil of the Summit silt loam to a depth of about 12 inches is a brown to dark-brown mellow silt loam, which sometimes varies locally from yellowish brown to nearly black. This material grades into a yellowish-brown friable clay loam, mottled with red, yellow, and brown. A light-brown to brown friable clay, somewhat mottled with red in the upper portion, is encountered at about 18 to 20 inches. With increasing depth the brown color gives way to a yellowish brown, and the red mottlings become fainter, the material having a yellowish or rusty-brown color. Both the subsurface soil and subsoil frequently contain fragments of limestone or chert, and in the subsoil black oxide of iron concretions and concretionary material are sometimes found. The subsoil is brittle or moderately crumbly.

Small areas of this soil occur in various parts of the county. The main development of the type is in Sheridan Township, in the northwestern corner of the county, where it is the most important agricultural soil. In this vicinity the Summit and the Oswego soils are locally referred to as "black land," and are much more highly esteemed than the lighter colored prairie soils.

This soil is residual, being derived from the weathering of Carboniferous limestone, associated or interbedded with fine-grained micaceous sandstones and calcareous and noncalcareous shales. Among the parent rocks shales predominate, but the thin-bedded limestones have an important influence on the resulting soil. The various rocks entering into the composition of this type outcrop in many places on the slopes, and are frequently within a few inches of the surface on the crests of the slopes.

The topography is gently rolling, the type occupying low, narrow ridges and intervening slopes. It occasionally extends over more nearly level areas at the foot of the slopes. The rolling topography insures fairly good surface drainage. The subsoil, while friable, is compact, and does not permit the rapid penetration of water, such as is necessary for adequate drainage after very heavy rains. In places, especially on the more nearly level areas, tile drains would be beneficial, both in removing surplus water and in providing more thorough aeration.

The Summit silt loam was originally a prairie soil. On the steeper slopes along the stream courses, where the soil is thinner and more broken, it supports a scanty growth of persimmon, oak, hickory, and walnut.

The Summit silt loam is one of the best general farming soils of the county. With the exception of the Crawford silt loam, this type is regarded as the best upland corn soil of the county. Owing to its mellow surface soil, good surface drainage, and heavy but friable subsoil, the type is particularly adapted to this crop. Corn yields from 40 to 50 bushels per acre, oats about 40 bushels, wheat 15 to 20 bushels, and prairie hay about 1 ton. Some alfalfa is now being grown, and the acreage of this valuable crop should be increased. It is grown without liming or inoculation. Three cuttings of about a ton per acre each are secured. Red clover also makes a good growth.

CLARKSVILLE STONY LOAM.

The surface soil of the Clarksville stony loam consists of a yellowish-brown to light-gray silty loam and extends to a depth of 6 to 8 inches. The subsoil is a yellowish to brownish silty clay, which is often bright red in the lower part. Both soil and subsoil contain large quantities of angular chert fragments of varying size.

The type is developed only in the southeastern corner of the county, in the Kansas extension of the Ozark region. The topography is rolling to hilly, and drainage is well established. The region in which this type occurs is locally referred to as stony hills. It embraces rather steep slopes, and has a generally rough, broken configuration.

This soil is residual from cherty limestone. Erosion has kept pace with weathering to such an extent that the soil is not deep, and the type is characterized by the presence of rock fragments, usually in quantities sufficient to prevent cultivation.

The type is largely covered by a growth of scrub oaks, with occasionally a few persimmon trees. Very little of the type is used for agriculture. It is seldom utilized for general farm crops, but produces good fruit, especially apples. Some of the largest orchards in the Ozark region are located on this type.

CRAWFORD SILT LOAM.

The Crawford silt loam, locally known as "red land," consists of a brown, dark-brown, or reddish-brown mellow silt loam to a depth of 8 or 10 inches, underlain by a reddish-brown friable clay which becomes heavier and more intense in color with depth, the deep subsoil being a rather plastic clay of pronounced red color. Both the soil and subsoil contain numerous fragments of limestone. Some iron concretions are found in the subsoil. Limestone rock underlies the type, and is often encountered at 22 to 36 inches.

The type is of small extent and is confined to a few small areas in the northwest corner of the county. It occurs within or adjacent to bodies of Summit silt loam, usually in the form of narrow bands above such areas. It occupies gentle slopes and narrow ridges and has an undulating to gently rolling topography. The natural drainage is good. The Crawford silt loam is derived principally from the weathering of the underlying limestone. The surface soil, however, may have been influenced to some extent by the shales and sandstones entering into the composition of the adjoining Summit and Oswego soils, from which some material may wash down over this type.

The Crawford silt loam has the essential characteristics of a good corn soil, and is generally considered the best upland soil of the county for this crop. Yields of 50 to 60 bushels of corn, 18 to 25 bushels of wheat, 25 to 40 bushels of oats, and about 1 ton of wild hay per acre are obtained. No alfalfa is grown at present, but the nature of the soil and the strong growth of sweet clover indicate that it would prove successful.

OSAGE CLAY.

The Osage clay consists of a black, waxy, plastic clay of variable depth, 15 to 18 inches being about the average, underlain by a drab or dark-drab to dark grayish brown clay. The subsoil sometimes has rusty mottlings from ferruginous material in the lower depths. In places there is but a slight difference between the soil and subsoil, either in color or texture.

This type is alluvial in origin, and occurs along the Neosho River and Lightning Creek, comprising a large part of the "Neosho bottoms" in the southwestern part of the county. In this locality it has a width of several miles. It is subject to frequent and prolonged overflow. On thorough drying the soil breaks up into cubical blocks, and large cracks form, sometimes being 3 or 4 inches wide and several feet deep.

The Osage clay has an almost level topography, and for any other utilization than for hay artificial drainage is absolutely necessary. Open ditches are common, but are inadequate.

The type is partly forested, although most of it consists of natural meadow. The forest growth includes oaks, pecan, and walnut, with occasional elms, hickories, and sycamores. The grass in the swales is a marsh or water-loving grass. Two cuttings are made, as the quality of hay is much better where the grass is not allowed to get too coarse and rank. Yields of one-half ton to a ton per acre are obtained from each cutting. Sometimes the second cutting is used for silage, in which case it is mixed with sorghum. The hay is considered excellent for horses, and most of it is shipped to Kansas City.

The Osage clay is a strong soil of high natural fertility, and with adequate protection against overflow and the installation of tile drains it would prove a productive and valuable soil. Some of the more favorably situated areas are cultivated, but crops are subject to injury from late spring or summer overflows. During favorable seasons yields of 30 to 50 bushels of corn, and 10 to 35 bushels of wheat are obtained. Oats are unsatisfactory because of their tendency to grow too rank. Some farmers claim that if corn is grown several years in succession on the same soil, and then followed by oats, yields of 30 to 40 bushels can be secured.

Alfalfa is grown without liming or inoculation. Over a large area of this soil, just over the line in Labette County, levees and tile drains have been established. In this area an average total yield of $4\frac{1}{2}$ tons of alfalfa in three cuttings is produced. In the same area ordinary yields of 35 to 50 bushels of corn, 30 to 35 bushels of wheat, and 40 to 50 bushels of oats are secured.

A movement was inaugurated a few years ago to levee and drain a large area, including some 27,000 acres, in Cherokee County, but the project was abandoned because of lack of cooperation among the owners. This area includes some other bottom soils, but the greater part of it is the Osage clay. The Osage clay has an average value of about $25 an acre, but when leveed and drained it is worth $100 or more.

OSAGE SILTY CLAY LOAM.

The Osage silty clay loam is an alluvial soil intermediate in color and texture between the Osage silt loam and the Osage clay. The soil to a depth of 8 to 14 inches is a brownish-gray to dark-gray silty clay loam, grading into a clay loam of somewhat lighter color and heavier texture. This surface soil is nearly black when thoroughly wet. The subsoil is encountered at 16 to 20 inches. It consists of a dark-gray to nearly black clay loam to silty clay which is often very heavy and plastic. In places the subsoil is yellowish brown, faintly mottled with rusty brown.

This type is subject to frequent overflows, like the other types of the Osage series, and because of this fact is a rather unsatisfactory soil. The topography is level. The type usually occurs at a slightly

higher elevation than the Osage clay and slightly lower than the Osage silt loam. It is developed in small areas in the bottoms of the Neosho River and Lightning Creek and is a comparatively unimportant type. It is often forested with oak, sycamore, cottonwood, ash, persimmon, pecan, and elm.

On drying, this soil cracks considerably. Applications of lime would be beneficial, as on the Osage clay, causing flocculation of the clay particles, and thus improving internal drainage and making cultivation less difficult. The Osage silty clay loam is used principally for corn, yields of 40 to 65 bushels per acre being obtained. Wheat also does well, producing about 25 to 30 bushels in favorable seasons, but the type is often too wet for wheat.

The land is valued at $35 to $50 an acre.

OSAGE SILT LOAM.

The soil of the Osage silt loam to a depth of 8 to 14 inches consists of a gray silt loam. Underlying this surface soil is a light-gray to nearly white floury silt loam, usually mottled with rusty brown and yellow, and containing concretions and concretionary material of ferruginous character. The subsoil from 24 to 30 inches is a drab silty clay, mottled with rusty brown. This heavy subsoil may be absent in the 36-inch section. In places streaks of sandy material occur. The type is variable, especially in the subsoil, but is characterized by the gray silty surface soil and lighter gray, mottled subsurface soil.

The Osage silt loam is an alluvial soil, and is found in practically all of the stream bottoms. It has its greatest development along such streams as Cherry and Fly Creeks. Often where a number of draws or minor drainage ways unite to form a small stream, the Osage loam gives place to the Osage silt loam, which typically continues along the stream to the main river bottoms. Sometimes a belt of the silt loam occurs along the streams through the river bottoms. Narrow, slightly elevated bands occur disconnectedly along the rivers and large creeks. Such areas are usually more brownish in color, and of a slightly lighter texture than the main body of gray material. This brown phase, owing to its slightly elevated position and slightly lighter texture, has better drainage than the typical areas.

The type as a whole has a level topography. Sometimes there is a very slight slope, usually away from the stream, particularly where areas of heavier textured bottom soils lie between it and the upland. It is subject to frequent and prolonged overflow, and, owing to the heavy subsoil or substratum and generally level surface, both the surface and internal drainage are deficient. A large part of the type is crawfishy and wet through much of the summer.

The Osage silt loam is one of the few naturally forested types of the county, though not all of it was originally covered with trees. When the first settlers arrived the only timber to be found was in the bottoms, and for this reason the homesteads usually bordered or included bottom land. Water oak and walnut are the principal species on this type, with some elm and sycamore.

In its natural state the Osage silt loam is an uncertain agricultural type, owing to its poor drainage and liability to overflow. A large part of the type is still forested and much of the remainder is used for hay and pasture. Owing to the crooked, winding channels of the streams and the large volume of water they receive after heavy rains overflows are general, and cooperation on a large scale is necessary adequately to improve the conditions of practically all of the bottom soils of the county. Some attempts at drainage have been made, particularly in the area near the junction of Cherry and Center Creeks, and that near the point at which Fly and Little Fly Creeks unite, in the Neosho bottoms.

The Osage silt loam is particularly adapted to corn and alfalfa where danger from overflow is not great. The brown, lighter phase produces excellent corn, and is the soil most commonly used for alfalfa, giving very good results with this crop. Yields of 4 to 5 tons are secured without inoculation or liming. Good yields of wheat are secured in favorable seasons, and it is claimed that this crop stands overflow well, even after the grain has formed, providing the heads are not covered. On the better drained areas of this type yields of 30 to 50 bushels of corn per acre are obtained. Oats produce from 20 to 30 bushels and wheat from 10 to 40 bushels per acre.

In the more favorable situations this land sells for $50 to $60 an acre, but the greater part of the type has an average value approximating $25.

OSAGE LOAM.

The Osage loam is not uniform in texture or color, being similar in this respect to Meadow. Typically the soil is a loam to silty loam, but varies, in many places within a short distance, from a rather sandy loam to a silty clay loam. It has ordinarily a grayish-brown to dark-brown color, and when wet is often nearly black. Rust-brown mottlings are common in both soil and subsoil. There is usually no marked difference between the soil and subsoil, although in places the subsoil may be considerably heavier. This type occurs exclusively in the draws and minor drainage ways of the prairie soils.

Most of the material composing the Osage loam is alluvial in origin, having been washed down from the fields and slopes drained by the intermittent streams or draws in which the type is found. Some of the material is colluvial, being moved down the sides of the draws by gravity and eventually being mixed with the darker alluvial soil

nearer the bottom. Thus the type is really composed of alluvio-colluvial material, but in this report it is classed with the alluvial soils. In the bottom of nearly every draw is a channel where active erosion takes place. Most of the draw and the sloping sides are covered with a thick sod, where deposition and some erosion occur after heavy rains.

The type is of small extent, even in aggregate, but differs so widely from the soils in which it occurs that its separation seemed advisable. It is almost always left in sod, and is generally used for pasture, but where the draws are shallow and gently sloping the grass is cut with that of the surrounding fields. If the sod were removed, erosion would prove much more destructive.

This type would undoubtedly give excellent yields of many crops, particularly potatoes and corn. It also seems adapted to alfalfa, but, owing to its liability to overflow and erosion during heavy rains, it is not used for crop production.

NEOSHO SILT LOAM.

The typical soil of the Neosho silt loam is a light-gray or ashy, floury silt loam, underlain at about 8 to 12 inches by a layer of nearly white, more compact silt loam. It is somewhat variable in depth. Where erosion has occurred it is very shallow, while in other places it extends to a depth of about 2 feet. The subsoil, beginning, as a rule, abruptly at about 14 to 18 inches, consists of a drab to dark-drab or nearly black clay, very tough, dense, and plastic. This clay usually extends to about 30 inches, where yellowish-brown mottlings sometimes appear. Below this the material is slightly more friable, owing to a higher content of silt or to the presence of pockets of grayish or yellowish-drab silty material. The substratum, as seen in cuts or deep ditches, is a heavy clay mottled with yellowish and grayish colors. This substratum on exposure cracks in a manner characteristic of heavy clay. Rounded chert gravel is often found in this substratum, and sometimes in the 3-foot section. Deep excavations, as for wells, disclose large quantities of this material, which is locally "river gravel," and it is sometimes encountered at varying depths in digging post holes. Typically the subsoil is a solid drab, becoming slightly lighter in color with increase in depth, and often the yellowish, slightly lighter textured material of the lower subsoil is not present. Along Lightning Creek red mottlings sometimes occur in the subsoil, but typically these are not present.

The soil has a lifeless appearance, characteristic of many imperfectly drained silt loams. The topography is practically level. There is a very slight slope toward the large streams and toward the main river bottoms.

This soil is of alluvial origin. The material was washed largely from sandstone, shale, and limestone soils of the prairie regions and deposited by stream overflow before the overflows were lowered by the deepening of the stream channels.

The type occurs as second-bottom or terrace areas lying from 5 to 15 feet above the bottoms along the Neosho River and Lightning, Cherry, and Shawnee Creeks. It is developed as a belt along the river, unbroken except by bottom soils, and varying from 1 to 4 miles in width. An area unconnected with the main type is found adjoining Lightning Creek, about 10 miles from the river, and various smaller areas extend along Cherry Creek for a few miles. An area along Shawnee Creek represents the only occurrence of the type in the county outside of the Neosho River basin. The largest development of the type is in Lola Township. The difference between this soil and the "white ashy land" or Cherokee silt loam, which it resembles in some respects, is locally recognized.

Owing to its level topography and to the very heavy subsoil, the drainage of the Neosho silt loam is poor. There are enough draws in the type to provide outlets for drains. In the few areas where the slope is comparatively steep, as adjacent to the bottoms and larger streams, erosion is rather a serious factor. Gullying and washing form draws which extend far back into the main type. Such areas are usually left in sod, which prevents serious washing. The type has a low organic-matter content and is acid. The addition of organic matter and the correction of acidity, together with improvement of the drainage, is essential to its best utilization.

The Neosho silt loam is naturally adapted to small grains and grass, and is largely used for these crops, wheat and prairie hay being the crops chiefly grown. Yields of 30 bushels per acre of wheat have been obtained, but the average is about 15 bushels. It is a common practice to grow wheat continuously for many years on the same field. The straw is burned and a marked depletion of organic matter results, giving the soil its lifeless appearance. Corn yields from 20 to 30 bushels per acre, with a maximum of about 40 bushels, 25 bushels being about the average. Oats yield as high as 60 bushels to the acre, but the average is much lower, being about 20 to 25 bushels. A large part of this type is used for prairie hay, many fields never having been plowed. Yields of three-fourths to 1½ tons are secured, with an average of about 1 ton per acre.

Applications of some form of "bone" (phosphatic) fertilizer, varying from about 75 to 150 pounds per acre are commonly made for wheat. It is generally considered useless to attempt to grow wheat without applying such fertilizer, and its use at the rate of about 80 pounds per acre results in materially increased yields. Applications of manure have a beneficial effect for several years, due largely no

doubt to the heavy subsoil, which prevents leaching. Heavy applications of lime, preferably the ground limestone, the improvement of drainage conditions, which may be best effected by tile drains, although subsoiling or dynamiting would doubtless be of great benefit, and a crop rotation including some legume and providing for the incorporation of organic matter, are practices which should be followed to put this soil in the state of productiveness necessary for maximum crop yields.

The price of the Neosho silt loam is probably higher than its present condition warrants, it being held in some cases at $75 an acre. The ordinary price asked is $35 to $50 an acre.

HUNTINGTON SILT LOAM.

The Huntington silt loam consists of a brown, mellow silt loam, with a depth of 12 to 14 inches, grading into a yellowish-brown, more compact silt loam or silty clay loam. In local areas, however, there occur in the subsoil strata varying from a gray fine sandy loam to a grayish, brownish, or drab silty clay. Such local variation may be expected in the subsoil of nearly all alluvial types.

The type occurs as first-bottom land along Spring River and its tributaries, particularly Cow Creek. Two small bodies are developed in the Spring River bottoms, which had they been of greater extent would have been mapped as the Huntington silty clay. One occurs northeast of the pond formed by the dams in Spring River at Lowell, and the other just south of the Boston Mills School. These variations from the main type have a dark-brown to nearly black heavy silt loam or silty clay loam surface soil, underlain by a dark to nearly black silty clay which is in places quite plastic and impervious. This variation occurs in depressions in the silt loam, where water stands longer after overflows and where large quantities of organic matter have accumulated. These developments have an aggregate area of scarcely one-third of a square mile.

The Huntington silt loam is composed of material washed in part from the sandstone and shale soils of the adjacent prairies and in part from the soils derived from the cherty limestone of the Ozark region. The topography is level, and in many places, particularly in those local areas where the subsoil consists of or contains heavy material, artificial drainage would prove beneficial. This type, however, is undoubtedly the best drained of any of the bottom soils of the county.

In its natural state much of the type was covered with a growth of oak, walnut, and elm, and many small areas are still forested, particularly those areas most subject to overflow. The Huntington silt loam is used largely for corn and grass. Alfalfa would undoubtedly do well, if it could be protected from overflow, as would wheat and

potatoes. Good yields are now secured in favorable seasons. Corn yields from 30 to 60 bushels, with an average of about 40 bushels, wheat from 20 to 35 bushels, and hay from 1 ton to 1½ tons, per acre. It is advisable to grow alsike in preference to the other clovers, as this has been found to do especially well.

The type sells for $25 to $50 an acre, and has an average value of about $35.

HOLLY SILT LOAM.

The Holly silt loam consists of a brownish-gray to gray silt loam to about 8 or 10 inches, where it grades into a light-gray to nearly white floury silt loam which contains some iron concretions and concretionary material, giving rise to rusty-brown and black mottlings. At about 20 to 22 inches this subsurface material becomes more compact, and at 24 to 28 inches it grades into a drab silty clay loam to silty clay, mottled with yellowish brown and yellow.

The type occurs as first bottoms along Spring River, nowhere in large areas, and usually associated with bodies of Huntington silt loam.

This soil is of alluvial origin. It is derived from wash from both cherty limestone and from the prairie shale and sandstone soils. The presence of the material from limestone is the factor differentiating the type. The topography is level. The soil needs drainage badly, and field tests with litmus paper show a decidedly acid reaction. The incorporation of organic matter, the establishment of tile drainage, and heavy applications of lime would result in marked improvement

The Holly silt loam is used mainly for corn, the yields varying greatly with the season, and for hay and pasturage, to which it is better adapted in its present condition. With adequate drainage and the addition of organic matter it should prove well adapted to wheat.

ROBERTSVILLE SILT LOAM.

The soil of the Robertsville silt loam to a depth of about 8 to 12 inches is a gray silt loam which is very light gray or almost white when dry. This surface soil grades into an almost white floury silt loam, which is considerably mottled with rusty brown and contains brown ferruginous concretions and concretionary material. This subsurface material at about 16 to 20 inches passes into the subsoil proper, consisting of a drab, very plastic, heavy, intractable clay. This material is often mottled with red or reddish brown for a few inches, and with yellowish brown below. At about 30 inches the drab color gives way to a grayish brown, with light-drab or yellowish-brown mottlings. Some small, well-rounded gravel is found in the subsurface soil and subsoil, and occasionally on slight

elevations this material is present in considerable quantities on the surface.

The type occurs along Spring River, being typically developed between this stream and Shawnee Creek, near the Boston Mills Bridge, and also on the wide terrace along Spring River east and northeast of Baxter Springs. The topography is level, and drainage is deficient. Although the type is somewhat elevated, the soil remains saturated after heavy rains, owing to the impervious subsoil and level topography.

The soil is alluvial in origin. It is developed as a second bottom (stream terrace) lying either completely or largely above overflow. The material consists of wash from shale, sandstone, and cherty limestone soils, mainly from the Ozark region to the east.

The Robertsville silt loam resembles the Neosho silt loam in many respects, and like it is used largely for wheat and grass. Yields vary greatly, depending on the season. The water-holding power of the soil is low, owing to the deficiency of organic matter and to the impervious subsoil. Considerable damage to crops results from heavy rains. The ridges which form the plant beds are washed down, furrows are filled up, and the crop may be almost completely drowned out. On the other hand, because of its inability to hold moisture, in times of drought this soil is likely to dry out so completely that crops may be an utter failure from this cause. Deeper plowing, the incorporation of organic matter, and tile drainage would so improve the physical condition of the soil that the damage from either excessive moisture or the lack of a normal supply would be very greatly reduced.

In normal seasons, this soil yields from 25 to 55 bushels of corn per acre, with an average of about 35 bushels, and from 12 to 25 bushels of wheat per acre. Alfalfa makes a good growth, but is liable to be burned out during droughts. Cowpeas, millet, and oats all give fair yields in normal seasons.

The value of the Robertsville silt loam varies from $40 to $75 an acre, depending largely on location.

The results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of this type are given in the following table:

Mechanical analyses of Robertsville 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.*
381309	Soil	0.0	0.6	1.1	7.0	7.6	78.9	4.6
381310	Subsoil	1.2	1.7	1.2	6.3	8.8	66.8	14.3
381311	Lower subsoil	.4	.7	.6	4.7	5.5	51.0	37.2

RIVERTON SILT LOAM.

The soil of the Riverton silt loam consists of a grayish-brown to brown, mellow silt loam, with a depth of 10 to 12 inches. In the lower few inches the soil is sometimes lighter in color and mottled with rusty brown. It passes into a light-brown to yellowish-brown silt loam to silty clay loam which is often mottled with rusty brown to a depth of 18 to 20 inches. Beneath this the subsoil is a yellowish-brown, brown, or reddish-brown plastic clay, mottled with bright red and yellow and sometimes with drab. Occasionally small, rounded chert and limestone gravel occurs on the surface, and throughout the soil and subsoil. In places the gravel is present in the subsoil in quantities large enough to make boring impossible, but as a rule the gravel stratum is below the 3-foot section.

This type occurs as terraces along and near Spring River. It is not confined to the immediate vicinity of the river, some areas being mapped 4 miles from the stream. It extends still farther east for a considerable distance into Missouri. The topography of the Riverton silt loam is for the most part level, but some of the higher terraces have been badly dissected by erosion.

Although occurring uniformly as terraces, the type varies greatly in its elevation above the river. Its ordinary elevation is between 10 to 25 feet, as in the area just south of Lawton, near the point at which the Spring River enters the county, and in the area near Riverton. There are occasional small bodies but a few feet above overflow, as the one just west of Lowell. Other well-developed areas, however, lie far above the river, as for instance that south of Galena, bordering the State line, and near the West Tennessee Prairie School, in the southeast corner of the county. The two bodies in this locality are probably over a hundred feet above the river, and parts of them are over 4 miles from the river. The occurrence of typical alluvial material at such distances from and at such elevations above the river has never been satisfactorily explained. Possibly at one time Shoal Creek was a much larger stream, and its channel nearer the present elevation of the high-lying Riverton soils. It may have overflowed large areas in this corner of the county and contiguous territory in southwest Missouri.

The Riverton silt loam is an alluvial soil consisting mainly of material washed from the cherty limestone soils of the Ozark region, with some shale and sandstone material from the prairies.

Although underlain by gravel in many places, this soil is inadequately drained, because of the heavy clay subsoil. Tile drains would materially benefit the soil.

The Riverton silt loam with ordinary management is a good general farming soil. Alfalfa may be produced without inoculation or lime,

but none is now grown. Corn yields from 30 to 40 bushels, oats from 30 to 40 bushels, and wheat about 20 bushels per acre.

The type has a relatively high value, as it is usually considered the best soil in the vicinity in which it is found. The average price is about $50 an acre.

Riverton silt loam, shallow phase.—The Riverton silt loam, shallow phase, consists of a grayish-brown to brown, mellow silt loam, underlain at about 8 to 10 inches by a lighter brown to reddish-brown silty clay loam, which at 14 to 24 inches is underlain by a stratum consisting mainly of rounded and angular chert fragments. Where this chert stratum is deep, the subsoil is a reddish clay, becoming redder and more plastic with depth. Rounded and angular fragments of chert occur on the surface, being particularly noticeable on the slopes.

This soil represents an eroded phase of the Riverton silt loam. It is associated with the latter soil and also with the Clarksville stony loam, usually occupying an intermediate position between these two types. The originally level surface has been dissected by erosion, so that the phase has a rolling topography. It is often found on the slopes of streams in areas of the Riverton silt loam. It differs from this type only in depth. On the more eroded slopes, the chert fragments are very abundant in places, suggesting the Clarksville stony loam, but waterworn material is always present in varying quantities. Typical areas occur at South Galena, Empire City, and northwest of Empire City, the latter area forming the dissected border of the adjoining body of Riverton silt loam.

The type has been formed by stream deposition of material washed from the cherty limestones of the Ozark region, with some influence from the shales and sandstones of the prairies, such material having been laid down when the waters of the streams reached much higher levels than at present. The angular cherty material underlying the type has been moved but little, if any, by water, while the rounded gravel and stones have been subjected to the influence of flowing water. Subsequent erosion has removed much of the original material, resulting in the wide variation in depth, stone content, and surface configuration.

This phase is not as extensively used for agriculture as the main type. Parts of it are forested with oak. Some corn is grown, giving fair yields in seasons of adequate rainfall. It would undoubtedly produce good yields of strawberries and potatoes, and peaches and apples should succeed.

The results of mechanical analyses of samples of the soil and subsoil of typical Riverton silt loam are given in the table following.

Mechanical analyses of Riverton 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.*
381301	Soil	0.0	1.7	2.1	11.7	10.4	68.9	5.5
381302	Subsoil	.2	.9	1.5	9.8	9.2	51.1	27.6

RIVERTON GRAVELLY LOAM.

The Riverton gravelly loam consists of a brown to grayish-brown silty loam, underlain at a depth of about 6 to 8 inches by a lighter brown silty clay loam, which passes into a reddish-brown to red clay loam to clay at 15 to 18 inches. This heavy subsoil is often absent and is never of great thickness, giving way to a stratum of chert gravel and fragments. The gravel, generally well rounded, is scattered over the surface and throughout the soil, often in quantities sufficient to interfere with cultivation. The stratum of gravel is usually encountered at 16 to 30 inches. It occurs not so much as an abrupt stratum but rather as a layer of material in which the gravel content gradually becomes so great as to prevent further penetration of the soil auger.

One area of this soil, occurring along Spring River about 1 mile north of the Boston Mills School in Shawnee Township, differs from the main type in having so high a content of fine to medium textured sand that it is really a gravelly sandy loam. Here there is an abundance of chert gravel and angular fragments both on the surface and in the soil, and this material is especially abundant in the subsoil. There are also numerous rounded and angular sandstone fragments of varying size in this area of the type, which if of greater size would have been mapped as Riverton gravelly sandy loam. This phase is not used for agriculture. It supports a rather heavy growth of oak.

The topography of the Riverton gravelly loam is undulating to gently rolling. The type is of small extent, being practically confined to narrow strips and bands. It has a greater development in the country to the east along Spring River and Center Creek in Missouri. The soil occupies relatively high, old terraces along Spring River, which have been dissected by erosion. It usually occurs on the outer edges of such terraces, bordering the river, as in the area just northeast of Riverton, or on the edge of the high terrace, adjacent to the lower, more recent terrace, as in the vicinity of Star School, east of Baxter Springs. Small areas are also found at much higher elevations and much farther from the river, associated with the Riverton silt loam and the shallow phase of that type. Very small areas are occasionally developed on the lower terraces.

The type is alluvial in origin. The material is mainly from the cherty limestone formations of the Ozark region, with doubtless some material from the prairie shales and sandstones. It was deposited when the streams flowed at much higher levels than at present.

The drainage of the Riverton gravelly loam is good to excessive, and yields are low in seasons of scant or infrequent rainfall. The type is used mainly for corn and pasture.

SHAWNEE SILT LOAM.

The Shawnee silt loam, to a depth of about 8 to 12 inches, is a brown silt loam, passing through a lighter brown silt loam into a brown silty clay subsoil at 15 to 20 inches. This subsoil is mottled with yellow, drab, and bright red, the yellow and drab mottlings usually occurring in the lower portion. In places the lower subsoil contains large quantities of black oxide of iron concretions and concretionary material.

This type resembles the Neosho silt loam in origin, material, and relative position, but is quite different in color, both of soil and subsoil. It also resembles the Riverton silt loam as developed on the low terraces, but differs from this soil in that it lacks the limestone material entering so largely into the composition of the Riverton soils.

The Shawnee silt loam is not extensive. The main development is in Pleasant View Township, in the northeastern part of the county, where the soil borders Cow and East Cow Creeks, attaining an average width of a half mile on each side of the stream.

The type is developed as second bottoms or terraces above normal overflow, although the lower areas or edges adjoining the bottoms are inundated for a short time during very high water. Its average position is about 10 to 15 feet above the adjacent bottoms. The type is alluvial in origin. The material is derived from the shale, sandstone, and limestone soils of the residual prairies, the material having been transported from its original position and deposited in its present location by the streams.

The topography is level. Owing to the heavy, plastic subsoil and the level surface, drainage is poor. This condition can be properly remedied only by the installation of tile drains. The use of lime is also recommended.

In its natural state the Shawnee silt loam supports a good growth of the common prairie grasses. It is used mainly for corn and grass.

MEADOW.

The material composing the beds of the drainage ways and minor streams in the southeast corner of the county, or in the group of soils largely influenced by the cherty limestone formation, has been classi-

fied as Meadow. The soil varies widely in texture, color, and depth, ranging from a fine sandy loam to a clay loam, and from gray to black in color. Chert gravel and fragments are abundant, in some places occurring as a substratum, and in others being scattered over the surface and throughout the soil material. The quantities of cherty material vary greatly within short distances.

Typical areas of Meadow occur along Killaboo Creek and minor drainage ways in the same locality. The Meadow areas are partly colluvial, but mainly alluvial, consisting of material washed down from the higher lying soils on the uplands and slopes. Drainage is characteristically poor. The surface material is usually dark to nearly black in color. The type is subject to overflow after each heavy rain, remaining in a wet or soggy condition for some time after such overflows, and is therefore of practically no agricultural value. The type sometimes supports a growth of walnut, elm, and oak.

SUMMARY.

Cherokee County is situated in the extreme southeastern corner of Kansas. It has an area of 585 square miles, or 374,400 acres.

The county consists mainly of rolling prairie with an elevation of 850 to 900 feet. A small section in the southeastern corner of the county, embracing the Kansas extension of the Ozark uplift, is hilly.

The county is drained by the Neosho and Spring Rivers, which enter at approximately the middle of opposite sides of the county and join a few miles south of the Oklahoma line.

The annual rainfall averages about 45 inches. The growing season averages 198 days. Periods of drought are not uncommon in the summer.

The county has a population of 38,162. Columbus, the county seat, situated in the center of the county, is the principal town, but Galena, with a population of 6,096, is the largest. The county includes numerous towns of fair size, several of which are incorporated as cities, and many villages.

The mining of soft coal and of zinc and lead are important industries, greatly exceeding agriculture in value of output.

Cherokee County has excellent transportation facilities. Kansas City and St. Louis are large markets quickly reached by good train service.

The highways of the county are very numerous and are in fair condition during the greater part of the year. The county is well supplied with schools, both town and country.

Grain production is the prevailing type of agriculture. Corn, wheat, and prairie hay are the principal crops, and the sale of these products constitutes the chief source of income of most farmers. Corn has by far the largest acreage, with prairie hay next, and

wheat and oats following. Only a small total area is devoted to other crops.

Not much difficulty is experienced with labor, as the type of agriculture commonly practiced largely demands extra labor only in haying and harvesting; when laborers from the mines are usually available.

Twenty-one types of soil, exclusive of Meadow, are found in the county. The upland soils are residual. They have been classified in the Cherokee, Bates, Crawford, Summit, and Oswego series, derived from sedimentary shales, sandstones, and limestones, and the Clarksville series, which comes from cherty limestones of the Ozark region. The Neosho, Shawnee, Robertsville, and Riverton series comprise the terrace or second-bottom soils, and the Osage, Huntington, and Holly the first-bottom soils. These terrace and bottom soils are alluvial in origin.

The Cherokee silt loam, locally called "white ashy land" and "hardpan land," is an extensive prairie soil. It is commonly in poor physical condition and needs drainage. It is used largely for wheat and grass, to which crops it is best adapted.

The Bates silt loam is best suited to corn, and is used largely for this crop. It is a good general farming soil. The Bates loam, fine sandy loam, and very fine sandy loam are locally known as "sandy land," and the fine sandy loam is also called "sweet-potato land." The types are used for general farming, but should be devoted to truck crops, sweet potatoes, and specialized agriculture. Crops are rather quickly affected by drought.

The Oswego clay and Oswego silty clay loam are locally called "black limestone land," but are derived from dark-colored shales, with very little limestone influence. They are strong soils, but need drainage. When drained they produce good yields of corn, wheat, alfalfa, and prairie hay.

The Summit silt loam is an excellent general farming soil, and produces alfalfa without the use of lime or inoculation. The type is not extensive.

The Crawford silt loam, of still smaller extent, is locally called "red land." It is residual from prairie limestone. It is a strong soil, of high agricultural value, and is especially adapted to corn.

The Clarksville stony loam is a very stony soil with a hilly topography. It is derived from the cherty limestone of the Ozark region and occurs only in the southeast corner of the county. It is practically unused for agriculture and is largely covered with oak forest.

The Neosho silt loam is a second-bottom or terrace soil, developed mainly along the Neosho River and tributary streams. It resembles the Cherokee silt loam in color and structure, and like it needs

organic matter and improvement of drainage. It is used largely for wheat and prairie hay and is best adapted to these crops.

The Shawnee silt loam is a brown terrace soil. It resembles the Neosho in many respects and has the same crop adaptations. It is of small extent in this county.

The Robertsville silt loam is a light-gray terrace soil, occurring along Spring River. It is formed largely of wash from the soils derived from cherty limestones of the Ozark region. It is easily affected by extremes of moisture conditions. In favorable seasons it gives good yields of corn, oats, wheat, and hay.

The Riverton silt loam, with its shallow phase, and the Riverton gravelly loam are also derived mainly from materials washed from the cherty limestone soils of the Ozark region with some influence from the prairie soils. The silt loam gives good results with ordinary farm crops.

The Holly and Huntington silt loams are first-bottom soils along Spring River. The Huntington is better drained than the Holly type and is a better agricultural soil. Corn is the principal crop grown on these soils, excellent yields being obtained, especially on the Huntington in favorable seasons.

The Osage soils are found along the Neosho River, its tributaries, and the streams draining the prairie soils. They are subject to overflow. The Osage clay has its largest development in the Neosho bottoms in the southwest part of the county. Where properly drained it is an excellent soil, giving good yields of corn, wheat, oats, and hay. A part of the type is forested with oak, pecan, and elm. The Osage silty clay loam is inextensive and of little present importance. It is generally forested. When drained it is an excellent soil. The Osage loam consists of the material washed into the draws and minor stream bottoms of the prairie soils. It is used only for pasture and occasionally for hay. The Osage silt loam occurs in the bottoms of the Neosho River and of the larger streams draining the prairie country. It is poorly drained. Corn and alfalfa are grown successfully on the higher lying and better drained areas. A large part of the type is forested with walnut, pecan, and oak.

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[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.]

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