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Soil Survey
of
Crawford County, Kansas

By

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and
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Bureau of Chemistry and Soils
In Cooperation with the Kansas Agricultural Experiment Station

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By M. H. LAYTON, in Charge, J. A. KERR, and E. W. KNOBEL, U. S. Department of Agriculture, and H. W. HIGBEE and R. W. O'HARA, Kansas Agricultural Experiment Station

COUNTY SURVEYED

Crawford County is in southeastern Kansas, in the second tier of counties from the Kansas-Oklahoma State line. It is bordered on the east by Missouri. Girard, the county seat, is about 130 miles south of Kansas City. The county is rectangular, being about 26 miles east and west and about 23 miles north and south. It has an area of 590 square miles or 377,600 acres.

Crawford County is just west of the Ozark region. It is part of a plain which has been dissected very slightly but which is itself a product of erosion and which may be considered a plain of denudation. The width of the creek valleys and flood plains varies considerably with the character of the rock through which the streams have cut. Where shale is the dominant rock the valleys and flood plains are broad, but where the creeks cross thin beds of limestone, which is more resistant to erosion than the sandstones and shales, the valleys and flood plains are narrow.

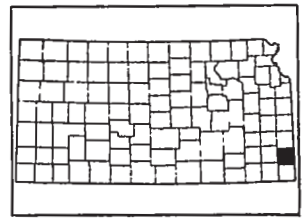

FIGURE 1.—Sketch map showing location of Crawford County, Kans.

Though the limestone beds are slightly more resistant to erosion than the sandstone and shale, the difference has not been sufficiently great to produce marked differences in relief. The plain is level or undulating, with a few winding ridges, the crests of which are locally marked by hillocks. In Lincoln Township, the stream bottoms are generally bordered by low limerock escarpments and the streams locally have rock-bound channels. The range of elevation in the county is not great. The elevations at Hepler and at Farlington, on the main watershed running diagonally across the northeast part of the county, are 1,001 and 996 feet above sea level,[1] respectively. The slopes from this main watershed are very gradual. The elevation at McCune, in the southwestern part of the county, is 921 feet and at Pittsburg, in the southeastern part, is 932 feet. In the northeastern corner of the county at Arcadia the lowest elevation of 823 feet is recorded.

Surface drainage of the county is generally good and underdrainage comparatively poor. Drainage is effected through numerous small streams radiating from the major divide which runs diagonally across the northeast part of the county. These streams are

[1] GANNETT, H. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. (Fourth Edition.) U. S. Geol. Survey Bul. 274, 1072 p. 1906.

sluggish and have meandering channels with a gradient of about 2 feet to the mile. The main streams flow intermittently during summer, but the deeper holes seldom if ever go dry. The streams that flow northward from the main divide empty into Osage River and those which flow southward into Neosho River and thence into Arkansas River. The streams which flow southward reach the Mississippi River in a somewhat shorter distance than those which flow northward.

The natural vegetation on the uplands consists almost entirely of grasses, two of the most abundant of which are bluestem and broom sedge. A number of wild legumes, such as prairie clover, hoary pea or catgut, and *Psoralea tenuiflora*, grow on the prairie lands. In long-overgrazed pastures many kinds of weeds have come up, the growth usually being much thicker than was that of the original prairie grasses. On the steeper slopes shrubs and vines such as butternut, wood vines, dogwood, sumac, bittersweet, wild grape, blackberry, willow, wild cherry, and persimmon are found. The alluvial lands were originally covered with timber and marsh grasses. The timber consisted chiefly of hackberry, elm, ash, pin oak, black walnut, cottonwood, locust, almond willow, sycamore, and black oak. In the northeast part of the county small areas of the stony upland are covered with a growth of post oak, black oak, maple, and a few other trees such as papaw and hawthorn.

On slopes where erosion has removed the soil material down to the partly decomposed sandstone and shale, needle grass has come in to some extent, but some spots of a few square feet are nearly bare of vegetation. Under prairie vegetation the uneroded soil has a very good supply of organic matter as the result of the favorable conditions for the accumulation and preservation of humus. This statement applies principally to the better-drained soils, as in the imperfectly drained soils the organic matter is seemingly not so abundant as that existing in the well-drained soils and the vegetation is not so vigorous.

Crawford County was organized shortly after the Civil War, but permanent settlement did not begin until about 1872. The population of the county in 1920 was 61,800. In 1920, 56.1 per cent of the total population was classed as rural, with a density of 57.3 persons to the square mile. About 90 per cent of the rural population in the southeast part of the county, which is the most densely populated part, are coal miners. Many of the miners and some of the truck farmers are foreign born. The coal industry creates a large nonagricultural population and is responsible for the building and development of a number of small towns and villages. The industry has a stimulating effect on agriculture, as it furnishes a large local market, especially for special crops such as truck and fruit, and for poultry.

Crawford County has adequate transportation facilities, furnished by the Atchison, Topeka & Santa Fe Railway, Kansas City Southern Railway, Missouri Pacific Railroad, St. Louis-San Francisco Railway, and Missouri, Kansas & Texas Railway. An electric line of the Joplin & Pittsburg Railroad connects most of the towns in the eastern half of the county. Most farms are within a short dis-

tance of shipping points. Sidetracks are numerous; from them carload lots of grain, grown in the vicinity, are shipped, and carloads of lime are sold near the place where it is to be used, making long hauls unnecessary.

The county highways are in good condition, and practically no point in the county is more than 4 miles from a graveled or paved road. Local roads are well maintained and many are well surfaced with chat, a fine cherty gravel from the zinc mines. County roads follow section lines.

Telephone service and rural delivery of mail reach all sections of the county.

School facilities are excellent. In Pittsburg there is a large State teachers' college and at Cherokee there is a county agricultural school. At least one good school is in each town, and more than 100 country schools are distributed throughout the county. Good public libraries are in Girard and Pittsburg, and the teachers' college has an excellent State library. Churches are in all the towns and are well distributed throughout the county.

In Crawford County thousands of laborers are employed in many industries other than agriculture. Among these are flour mills, grain elevators, creameries, and wholesale houses. Coal mining is closely associated with the agriculture of the county, because many of the miners also farm on a small scale. Several shallow oil wells are in the county; a chemical company is near Pittsburg; and in Girard there is a large printing plant.

Surplus farm products, including grain, hay, livestock, and dairy and poultry products, are usually marketed outside the county, although a large number of cattle and hogs are sold at the slaughterhouse at Pittsburg. Much of the wheat and hay is shipped to Kansas City. The greater part of the grain is handled in the local elevators, where it may be sold at once or stored until the price is satisfactory. Most of the dairy and poultry products are consumed locally.

Fruits and vegetables are grown for local markets during most of the year. Strawberries do well and many hundreds of crates are shipped out each season. Local markets for agricultural products are good, and, in addition to these, the county is in direct connection with Kansas City, Joplin, and St. Louis, Mo.

Water is readily obtained in all parts of the county. The upland wells are shallow and are allowed to fill during the rainy season. The shallow wells are preferred to the deeper ones for family use, as water from the deeper wells has a hydrogen-sulphide odor and tastes of sulphur. The deeper wells are generally used to supply water to livestock, and only when shallow wells go dry is water from the deeper wells used for human consumption.

CLIMATE

The climate of Crawford County is continental and is characterized by wide seasonal variations. It has an unusual combination of rainfall and sunshine. About 65 per cent of the average annual rainfall of 42.53 inches falls during the growing season, from April to September, inclusive. The rains generally come in the form of

thundershowers of short duration. The winters are mild, and blizzards are rare. Spring and fall are cool and windy, and summers are hot and generally dry. There is a marked variation in the average daily wind velocity, which increases toward the warmer part of the day and falls at night. High northerly winds often precede and accompany cold waves, but the most damaging winds are the hot winds which usually occur during prolonged dry periods. These winds come from the south or southwest and often are of high velocity. They come after the wheat is matured and damage only the late crops. Droughts are owing to the high rate of evaporation and large proportion of sunshine rather than to lack of rainfall.

Damage to crops from early and late frosts is rare. The average dates of the last killing frost at Columbus, Cherokee County, and at Fort Scott, Bourbon County, are April 9 and April 15, respectively, and the date of the latest recorded killing frost at each station is May 9. The average dates of the earliest frosts are October 23 and October 17, respectively, and of the earliest recorded are September 29 and September 26. This gives an average frost-free season of 197 days at Columbus and 185 days at Fort Scott. Records of the Weather Bureau station at Pittsburg are incomplete, hence are not cited.

Tables 1 and 2 give the normal monthly, seasonal, and annual temperature and precipitation as recorded at the Weather Bureau stations at Columbus and Fort Scott.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Columbus, Cherokee County, Kans.*

[Elevation, 898 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1917)	Total amount for the wettest year (1895)	Snow, average depth
	° *F.*	° *F.*	° *F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	34.0	78	−12	2.10	1.79	10.50	4.3
January	34.0	77	−18	1.87	.40	1.23	4.0
February	35.0	84	−28	2.00	.13	.13	4.8
Winter	34.3	84	−28	5.97	2.32	11.86	13.1
March	47.4	93	1	3.50	1.56	1.97	1.7
April	56.0	91	20	4.38	3.59	.50	.2
May	65.9	94	28	5.77	4.96	4.10	.0
Spring	56.4	94	1	13.65	10.11	6.57	1.9
June	74.6	107	44	5.37	3.42	8.67	.0
July	78.7	110	49	4.26	1.50	11.03	.0
August	78.2	109	41	3.82	5.87	5.54	.0
Summer	77.2	110	41	13.45	10.79	25.24	.0
September	71.2	107	32	3.92	3.06	10.12	.0
October	59.3	99	15	3.19	.37	.32	.2
November	47.5	87	4	2.35	2.61	4.19	.5
Fall	59.3	107	4	9.46	6.04	14.63	.7
Year	56.9	110	−28	42.53	29.26	58.30	15.7

TABLE 2.—*Normal monthly, seasonal, and annual temperature and precipitation at Fort Scott, Bourbon County, Kans.*

[Elevation, 857 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1917)	Total amount for the wettest year (1844)
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*
December	34.5	77	−10	1.78	0.60	0.78
January	32.7	74	−19	1.84	.35	2.05
February	34.3	84	−24	1.89	.05	1.30
Winter	33.8	84	−24	5.51	1.00	4.13
March	47.2	95	0	2.23	1.43	3.78
April	54.9	94	46	4.13	3.05	6.91
May	65.4	103	25	5.65	8.03	14.79
Spring	55.8	103	0	12.01	12.51	25.48
June	74.3	108	42	6.11	.50	12.64
July	78.5	108	48	4.41	3.06	10.50
August	78.3	111	42	3.62	4.33	2.51
Summer	77.0	111	42	14.14	7.89	25.65
September	70.6	105	29	3.93	5.18	3.33
October	59.2	96	17	2.86	.83	2.49
November	47.1	85	5	2.33	.14	1.52
Fall	59.0	105	5	9.12	6.15	7.34
Year	56.4	111	−24	40.78	27.55	62.60

AGRICULTURE

Agriculture was the primary interest of the settlers of Crawford County until 1877. The open prairie with trees along the creeks encouraged the development of farming. With the discovery of coal, agriculture became second in importance among the industries. Most of the land in the eastern half of the county was bought by the coal companies and leased to the farmers and men employed in the mines, who farmed as a side line. Only the better land was farmed. Agriculture consisted mainly of general farming, with corn, wheat, oats, and hay as the leading crops. Early in the history of the county cotton and tobacco were grown, but owing to the uncertainty of the season and small returns these crops gave way to wheat and corn. Flax, likewise, thrived for a short time, but lack of proper care and disease (flax wilt) caused a decrease in the acreage.

Early farming was carried on mainly along the stream bottoms and on the near-by uplands. Stock raising was by far the most important industry prior to the discovery of coal.

In the early seventies there were less than 40,000 acres of improved farm land in the county. During the following two decades development of the county progressed rapidly, and there was a steady increase in population, largely from Missouri, Indiana, and Illinois. About 1880 the building of the railroad marked the beginning of a change in the form of agriculture generally practiced. Cattle raising gave way to general farming, but the raising of livestock has remained one of the most important agricultural pursuits.

According to the census of 1925, the average size of the 2,720 farms in the county was 116.1 acres. The average value of all property to the farm was $6,873, and the average value of land an acre was $40.30. The percentage of the county in farms was 81.6 per cent. Tenants operated 38.3 per cent of the farms in the county.

Corn was the most important cultivated crop from the earliest settlement of the county to about 1915, when wheat became the leading crop. In spite of the fact that better varieties of corn have been introduced the acre yield decreased almost one-third between 1880 and 1920. Practically all the corn produced is used for feeding livestock on the farm or is sold locally.

Wheat assumed a position of importance about 1880, when the railroad afforded better marketing facilities. In spite of the fact that better varieties have been introduced the acre yield has decreased, owing probably to the fact that poorer land has been brought under cultivation and that the continuous cropping has reduced the organic-matter content of the soil. Wheat is the main cash crop, and most of it is shipped out of the county. Oats has been a comparatively unimportant crop, but it fits well in the crop rotation. The acreage varies from year to year. Sorghums, alfalfa, and prairie hay are also of minor importance.

Table 3 shows the acreage and production of leading crops, as reported by the census.

TABLE 3.—*Acreage and production of principal crops in Crawford County, Kans., in census years*

Crop	1879		1889		1899	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	81,347	2,797,340	99,642	3,091,304	105,681	2,499,770
Wheat	13,380	198,493	10,346	165,541	24,155	218,840
Oats	11,534	258,056	20,943	460,823	34,365	925,660
		Tons		*Tons*		*Tons*
Hay	28,234	28,621	56,253	65,606	[1] 47,274	59,633

Crop	1909		1919		1924	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	102,972	2,179,722	40,791	596,274	60,285	1,578,124
Wheat	16,293	221,629	84,032	1,697,622	38,580	297,122
Oats	18,664	477,328	38,826	1,022,676	33,350	639,865
		Tons		*Tons*		*Tons*
Hay	[1] 38,082	42,606	[1] 39,800	56,354	29,387	37,776

[1] Hay and forage.

About 70 carloads, or 1,050 tons, of commercial fertilizer are used yearly, according to the county agent's records. The fertilizers used are primarily superphosphate and bone meal.

Very little land has changed hands in the last few years. The price seems to depend on the prospects for coal, oil, and gas and on improvements rather than on the productiveness of the land. Prices range from $40 to $125 an acre.

Most of the labor on the farms is done by the farmer and his family, but exchange of labor between farmers is common practice during the busy harvest season. Most of the hired farm laborers are not efficient.

SOILS AND CROPS

About 90 per cent of the land in Crawford County is tillable. The remainder consists of strip pits, mine dumps, creek bottoms, and rough and stony land, part of which is in pasture. The tillable land is well suited topographically to farming and allows the use of labor-saving machinery. The greater part of the county is covered by soils of two main groups, representatives of both of which occur on many farms. The Summit soils and Cherokee soils are representative, respectively, of these two groups. The Summit group occupies about 25 per cent of the county and the Cherokee group the rest. The Summit group includes Summit silty clay loam with two phases, Summit stony silty clay, Labette silt loam, Newtonia silt loam with two phases, and Verdigris silt loam. The Cherokee group includes Cherokee silt loam, Parsons silt loam, Neosho silt loam, Bates loam, Bates very fine sandy loam, Bates silt loam, and Lightning silty clay loam.

In the following pages the various soils and their relation to the different crops will be discussed; their distribution is shown on the accompanying soil map; and their extent is shown in Table 4.

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

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Summit silty clay loam	65,920	18.8	Parsons silt loam	157,184	41.6
Shallow phase	3,584		Bates silt loam	26,048	6.9
Slope phase	1,600		Bates very fine sandy loam	4,672	1.2
Summit stony silty clay	2,944	.8	Bates loam	3,904	1.0
Labette silt loam	25,664	6.8	Neosho silt loam	3,200	.9
Newtonia silt loam	5,504	2.4	Lightning silty clay loam	9,216	2.4
Shallow phase	2,944		Mine pits and mine dumps	4,736	1.3
Eroded phase	64				
Verdigris silt loam	17,792	4.7	Total	377,600	
Cherokee silt loam	42,624	11.3			

SOILS OF THE SUMMIT GROUP

The soils of the Summit group occur mainly in the northeastern part of the county and in other parts where the land is rolling. These soils include the greater part of the so-called "black lands." The Cherokee group covers the rest of the county and includes the lighter-colored claypan soils.

The darker soils show less marked response to fertilizer than the lighter-colored claypan soils. They are almost neutral in reaction, whereas the lighter-colored claypan soils are acid.

In this region the character of the soils and the climate have greater influence on the kind of crop grown than has the location with respect to markets. About 85 per cent of the total acreage of the Summit group of soils is annually devoted to corn and the remainder to legumes, oats, wheat, and miscellaneous crops; about 40 per cent of the Cherokee group is annually devoted to wheat and the remainder to corn, kafir, flax, and miscellaneous grasses. The suitability of Summit silty clay loam and of most of the soils of the Summit group to corn in general is owing in part to the high content of organic matter, which constitutes from 3 to 5 per cent of the soil

to a depth ranging from 10 to 16 or more inches, to their water-holding capacity, their good drainage, and fair supply of mineral constituents. The organic matter is so intermixed with the mineral constituents that it is an integral part of the soil. It is an important factor in producing the soft crumb structure so desirable for tillage and is highly conducive to the maintenance of good moisture conditions. It is also the chief source of nitrogen, which is highly beneficial to successful plant growth. It is almost entirely in a form which does not suffer destructive decomposition under tillage.

The physical condition of these soils is generally good, enabling them to endure dry weather and to recover rapidly from the effects of heavy rains. Where erosion has removed the surface organic matter, the surface soil has a tendency to crack on drying, with deeper drying and cracking in the subsoil, and the physical condition is greatly impaired.

Summit silty clay loam.—Summit silty clay loam, the most extensive soil of the Summit group and the heaviest soil in the county, is characterized by a dark-colored surface soil and a friable subsoil, in contrast to the adjoining lighter-colored claypan soils. The subsoil consists of about equal parts of silt and clay and is permeable to air and water, largely because of its granular structure. On partly drying it becomes crumbly, which allows aeration, oxidation, and the internal movement of moisture. The crumblike condition endures in many places to a depth ranging from 15 to 30 inches. About 96 per cent of this soil is in cultivation, mainly to corn although many other crops do well. The high organic-matter content and the fine texture cause the soil to be somewhat too moist for wheat after the heavy spring rains, and in early spring most plants growing on it are pale green. The best-adapted varieties of corn are Midland Yellow Dent and Commercial White. They mature about one week later than most varieties, but the yield is considerably higher.

Summit silty clay loam, shallow phase.—The shallow phase of Summit silty clay loam is similar in its upper layers to the typical deep soil. The limestone bedrock, however, occurs at slighter depth, ranging in most places from 1 to 3 feet. This phase occurs in small areas mostly on slopes where erosion is active. This soil is somewhat less productive during dry years than the typical soil, but during seasons of high rainfall yields on the two soils are about the same. Cultivation is somewhat more difficult on the shallow soil on account of the limestone fragments in the soil and the slight depth to the bedrock. Erosion which has produced the shallow phase is still going on. This soil can best be used for clover pasture as clover grows well on it and retards erosion.

Summit silty clay loam, slope phase.—The slope phase of Summit silty clay loam occupies those steeper slopes which, for the most part, should not be put into cultivation to clean-tilled crops, at least not without some adequate means of checking the soil washing which is sure to follow such use. Possibly considerable protection could be had from properly constructed field terraces. In general, it may be the safer and more economical plan to keep such areas either in permanent grass, not subjected to overgrazing, or in timber. Some of these slopes have limestone very near the surface; in places, the rock outcrops. On the average the soil is shallower than typical Summit silty clay loam.

Summit stony silty clay.—Summit stony silty clay consists of a dark silty clay loam overlying bedrock limestone at a depth ranging from 6 to 24 inches. Small patches within the areas of this type may have little or no soil covering over the rock; in other places the soil may be as deep as in the typical Summit silty clay loam. The soil is developed over beds of platy limestone and calcareous shale. The lower part of the soil near the partly weathered rock is calcareous. The surface is gently to sharply rolling. This land is used mainly for pasture. Occasional patches of less stony land are mowed for hay.

Labette silt loam.—Labette silt loam is very similar in its agricultural adaptation to Summit silty clay loam. The soils differ slightly in color and organic-matter content, the Labette soil being better oxidized and browner in the surface layer and redder in the subsoil than the Summit. Nitrification begins earlier in the spring than in Summit silty clay loam. The Labette soil seems to contain less organic matter and to be slightly more acid than the Summit soil. Also the crumblike structure does not extend so deep, and there is some soft ferruginous red material in the subsoil. The subsoil is a little more compact and in places is rather heavy, but this condition generally occurs at too great a depth to affect most crops. This soil generally occupies the higher or better-drained areas in close association with the Summit soils and is slightly better suited to wheat than is Summit silty clay loam. The pale-green color characterizing plants growing on Summit silty clay loam in early spring is not so noticeable on this soil. Farmers generally feel that the Labette soil is not so well suited to alfalfa, as it requires heavier liming to produce a crop. However, alfalfa and the annual legumes do well where sufficient lime is added to neutralize the acidity. Farmers recognize this soil as being equal to the Summit agriculturally in all other features.

Newtonia silt loam.—Newtonia silt loam is very similar to the other soils in this group in its agricultural adaptation. It is of small extent but is important agriculturally. In cultivated fields it is locally called "red limestone soil." The surface soil is dark gray or dark brown but appears red in cultivated fields where organic matter is lacking. Nitrogen is generally not plentiful but sufficient is present to produce a good corn crop. The soil material is very friable, having a loose, imperfect crumblike structure. The iron content is very high and gives the soil a greasy feel when moist. In some places the organic layer is very thin and in other places it has entirely disappeared, leaving a red layer exposed. In such places the soil is inclined to be more droughty than elsewhere. This soil seems to be well suited to fruits such as peaches, pears, plums, cherries, and apples. Potatoes do especially well and mature much earlier than on Summit silty clay loam.

Newtonia silt loam, shallow phase.—The shallow phase of Newtonia silt loam differs from typical Newtonia silt loam only in its slighter depth. Bedrock lies at a depth of less than 3 feet and over the greater part of the area at a depth ranging from 12 to 24 inches. This soil is somewhat droughty in places, especially near outcrops of limestone. Alfalfa and the annual legumes thrive when sufficient lime is applied to neutralize the acidity. The early-maturing crops do well, as they mature before the late summer droughts set in.

Newtonia silt loam, eroded phase.—The eroded phase of Newtonia silt loam comprises sloping areas of tilled or formerly tilled land which, because of erosion, have lost a considerable part of the dark reddish topsoil. Since the subsurface layers of this soil are more reddish than the surface soil, this gradual planing off of the top has brought about a redder color and a condition less favorable to the retention of moisture. The more highly charged humous layer at the surface has been removed or partly removed by erosion and a stiffer, less readily penetrable soil of lighter clay content is left. This takes up rain water more slowly, gives it off more readily by evaporation in dry spells, and favors more rapid run-off. The soil, for these reasons, is less productive than the typical, uneroded soil. Locally, fields have been scarred with small gullies and washes that expose the clay subsoil.

Verdigris silt loam.—Verdigris silt loam consists of dark-brown friable silt loam. The surface soil is somewhat darker than the subsoil, but the texture is almost uniform to a depth of about 40 inches. The lower part of the subsoil is somewhat mottled in places. The soil has received much plant food from the surrounding lands and is in good physical condition. It occurs along the well-drained bottoms of the largest streams and is of small extent but is the most productive soil in the county. About 90 per cent is under cultivation. It is very highly valued for corn, alfalfa, and truck crops. Early floods sometimes cause considerable loss of early truck crops. All forage crops do well. Many farmers plant small patches of rape, turnips, and corn on this soil for hog pasture.

SOILS OF THE CHEROKEE GROUP

The soils of the Cherokee group are less favorable to the growth of plants than those of the Summit group. The organic-matter content is small, as compared to the Summit group, and the structure is less favorable for aeration, oxidation, and the movement of moisture. These soils do not favor deep rooting of plants, on account of the heavy claypan which restricts underdrainage and causes the formation of a temporarily high water table during wet weather. This heavy clay subsoil is too fine in texture for the plant roots to penetrate readily and the small roots are found mainly on the outer surfaces of the soil particles and between the cracks and cleavage planes. Optimum moisture conditions endure for only a short time. When the soil is too wet the plants feed only at the surface, as the deeper roots drown out, and when it is too dry the roots can not penetrate to any great depth as the clay expands and contracts, breaking them and exposing them to the dry air where they die. Good tilth is difficult to obtain. The heavy spring rains cause the soil to pack and puddle, and in many places water stands on the surface until it evaporates, leaving crops in poor condition to withstand dry weather.

Only shallow-rooted plants with wide-spreading root systems, such as the grain sorghums, wheat, meadow fescue, timothy, Hungarian grasses, and a few annual legumes, will grow well on these soils. The grain sorghums do well, as their growth and development are arrested in dry periods, and they mature later when the season is more favorable. Corn can not withstand the adverse moisture condi-

tions as well as the grain sorghums, and is a somewhat uncertain crop, but on the average produces approximately the same acre yields. Blackhull and red kafir are the better grain sorghums in the section. Atlas, Sumac, and Kansas Orange are the better varieties of sweet sorghum. Freed is the best grain sorghum for late planting. The Fulcaster variety of wheat yields from 2 to 4 bushels more to the acre on thin claypan soils than any other variety. Currell, Kanred, and Dunbar Currell are other varieties of wheat which produce well in this section of Kansas. In favorable years soybeans do well. These are grown for seed, hay, pasture, and soil improvement.

The claypan soils, all of which are light in color, have a smoother relief than the darker soils. This allows wheat and seed grasses to mature uniformly and simplifies harvesting.

Cherokee silt loam.—Cherokee silt loam is the least productive of the soils in the Cherokee group. It occupies the more nearly flat areas and the lack of relief, together with the heavy claypan subsoil, renders drainage poor in wet weather. The physical condition is in general very poor, and plowing when wet causes the material to puddle. The surface soil is grayish brown, the shade depending on the proportion of organic matter present. The lower part of the surface soil or the part just above the claypan has been severely leached and after plowing gives the field a light-gray appearance. The organic matter content is low.

Parsons silt loam.—Parsons silt loam closely resembles Cherokee silt loam except in the surface layer, which is somewhat darker in color, and in the layer just above the claypan, which is not so light a gray and which contains more organic matter and to a greater depth than the corresponding layer in the Cherokee soil. Owing to the greater content of organic matter in the latter layer the roots of plants ramify it much more easily than the corresponding layer of the Cherokee silt loam. Also, surface drainage is better and the claypan is exposed in more places on slopes, due to erosion, but in general the physical condition is a little better. The subsoil is not uniformly dense, and plants feed to some extent in it. Corn will produce fair yields, if the rainfall is sufficient during the late growing season. Cowpeas and soybeans do well, and corn following these legumes does better than the average.

Bates silt loam.—Bates silt loam consists of 8 to 12 inches of very dark grayish-brown silt loam, underlain by friable, granular yellow silty clay loam. At a depth ranging from 12 to 24 inches, the soil is underlain by thin-bedded yellow noncalcareous sandstone. Both surface soil and subsoil are acid. The claypan subsoil layers are absent or only slightly developed, but the impervious bedrock near the surface has a similar effect in holding water. This soil occurs mainly on the steeper slopes leading to creek valleys. Very little of the land is under cultivation and the greater part is in native prairie grasses. The grassland is used mainly for pasture, but a small part is cut for hay. The yield is almost a ton to the acre in exceptionally good seasons, but the more common yield is one-half to three-fourths ton. The areas with deeper soils and smoother surfaces are cultivated. Where the soil is 2 feet or more in depth, crops withstand drought. Yields depend both on the depth of the soil and the rainfall for the season. Kafir yields range from 10 to 60

bushels an acre; about 30 bushels is perhaps an average. Corn yields from 15 to 25 bushels and wheat 12 to 20 bushels. Some red clover and alfalfa are also grown.

Bates very fine sandy loam.—Bates very fine sandy loam differs from Bates silt loam chiefly in its lower percentage of silt and its higher percentage of very fine sand. The surface soil is darkened by organic matter to a depth of 3 or 4 inches. The underlying grayish-yellow fine sandy loam reaches a depth ranging from 10 to 18 inches and is underlain by a yellow friable sandy clay. At a slight depth, the soil is underlain by soft porous sandstone. The soil is everywhere strongly acid. The greater part of the areas of this soil is in forest. On the small cultivated areas corn, kafir, and oats make fair yields.

Bates loam.—Bates loam differs from Bates silt loam mainly in the texture of the surface soil which is a loam instead of a silt loam. The total depth of the soil layers over the sandstone or shale ranges from 15 to 30 inches. Both surface soil and subsoil are strongly acid. The greater part of this soil is in native grasses and is used for pasture. Although there is some variation in the stand and yield due to overgrazing, about 3 acres of pasture is required to keep a steer during the grazing season that lasts from April until frost in the fall. On the cultivated areas good crops of corn and kafir are produced in favorable years. The range in yield of kafir is from 20 to 40 bushels an acre, corn 15 to 25 bushels, oats 20 to 30 bushels, and wheat 12 to 20 bushels.

Neosho silt loam.—Neosho silt loam is similar to Cherokee silt loam in all its agricultural characteristics except its slightly greater ability to withstand drought, owing to its more favorable position and its less heavy claypan subsoil. This soil occurs along the terraces or second bottoms of the main streams in the county. It is seldom overflowed by the streams, but owing to the flatness of the areas water often stands on it after rains for a considerable time. As in the Cherokee soil, the surface soil is low in organic matter. The physical condition of the soil is poor, and the material is strongly acid throughout. Wheat appears to be the most popular crop, but kafir and many varieties of grasses do well. Corn is sometimes planted, but the yields are not so satisfactory as of the grass crops.

Lightning silty clay loam.—Lightning silty clay loam is of small extent and little agricultural importance in the county. It closely resembles, in its agricultural adaptations, the other soils in the light-colored claypan group. The physical characteristics of the surface soil are the same as of Cherokee silt loam. Poor drainage causes the same results as the claypan in leaching and root ramification. The main differences from the Cherokee soil are that the Lightning silty clay loam occurs along the more sluggish stream bottoms and has a friable subsoil. Its natural cover is a heavy growth of slough grasses. A small area is in cultivation; the rest is in pasture. Corn and sorghums are the main crops.

Mine pits and mine dumps.—Mine pits and mine dumps is a miscellaneous class of nonagricultural material occupying a small proportion of the county.

RECOMMENDATIONS FOR IMPROVEMENT OF CRAWFORD COUNTY SOILS

The productiveness of a soil can be increased or diminished by its treatment. Building up the productivity of a soil to a high level and then keeping it up is an achievement toward which every farmer should strive. The management of the farm should be as intelligent and as careful as that of any other business in which every process must be understood and regulated in order to obtain the most profitable results. The farmer's success depends largely on his knowledge and treatment of the soils; different soils present different problems as to treatment and kinds of crops to be grown. The requirements of the soils may differ greatly; both their chemical and physical condition must be understood. The requirements of plants also differ; the farmer should plant the crops whose needs can best be satisfied by his soil.

Many of the soils of Crawford County are somewhat lacking in available plant food, but their most serious need is organic matter. The growing of annual legumes such as cowpeas and soybeans is necessary to supply the soil with organic matter. Under the carefully worked-out cropping systems approximately one-fourth of the acreage should be planted to legumes, which should be fed to livestock and the manure returned to the soils. Clover and alfalfa are not grown very successfully on the heavy claypan soils, such as members of the Cherokee, Parsons, and Neosho series, without the application of large quantities of lime. Cowpeas and soybeans seem to thrive in all parts of the county and improve the soil whether grazed, cut, or plowed under. The hay from these annual legumes is equal in nutritive value to alfalfa or clover. The most popular varieties of cowpeas are Whippoorwill, Clay, and New Era. The popular varieties of soybeans are Peking, A. K., Morse, and Virginia. The Virginia gives the best results on the claypan soils.

The use of commercial fertilizers is well established. They increase hay and grain yields on most soils in the county. Superphosphate (acid phosphate) and bone meal are the most practical fertilizers used. The nitrogenous materials can be supplied most economically by the addition of manure or by growing legumes. Lime aids greatly in bringing about a more desirable condition of the soil, physically and chemically, as well as adding calcium. Correction of acidity is very desirable for the grass plants and seems to be necessary for legumes. Cherokee silt loam seems to respond better to fertilizers than any other soil in the county; the Parsons and Neosho soils respond well; but the use of fertilizers on Summit silty clay loam is not so profitable. Lime and superphosphate give good results on the Labette and Newtonia soils.

At the experiment substation at Parsons, Kans., alfalfa, corn, and wheat were planted in plots consisting of Cherokee, Bates, and Summit soils. All crops were much better on the Summit soils than on the Cherokee or Bates soils, but where fertilizers had been used the crops were more nearly uniform. The response to fertilizers was much greater on the Cherokee soil, but the total crop production was greater on the Summit soil.

SOILS AND THEIR INTERPRETATION

The soils of Crawford County have developed under a rainfall heavy enough to wet the soil to an indefinite depth, so that a moist condition, except in short periods in summer, is maintained throughout the soil and well into the parent rock. Part of the time the soil is not only moist but saturated. Tall grasses formed the cover under which the soils developed.

The heavy rainfall of the region is sufficient to leach the soluble salts, especially the carbonates, from the surface layers of the mature soils. Where not leached out these soluble salts are held in a dense claypan subsoil. In the virgin or uncultivated areas still covered with Andropogon grasses the surface layer is everywhere dark in color. This dark color increases as the pH value rises in the surface soil. The dark-colored surface layer is only 6 or 8 inches thick in some of the soils, such as the Newtonia and Cherokee, and farming operations have intermixed it with the lower lighter layers, causing the entire soil to appear lighter in color.

For convenience of description, the soils have been grouped according to certain common characteristics into the five following groups: (1) Cherokee, Parsons, and Neosho soils; (2) Summit soils; (3) Labette and Newtonia soils; (4) Bates soils; and (5) alluvial soils. The descriptions are of virgin soils under normal moisture conditions, unless otherwise stated.

The most extensive is the claypan group which includes the Cherokee, Parsons, and Neosho silt loams. These soils occupy slightly more than one-half the area of the county and are well distributed. The Cherokee and Neosho soils occur on the more level areas, and the Parsons occupy the more undulating or sloping areas. The areas of these soils are very closely associated, and as their greatest difference is in the surface soil their separation in the field is somewhat difficult. This difference in characteristics seems to have been brought about by topographic features, as all other factors are nearly equal. In a pit in the southwest corner of sec. 18, T. 28 S., R. 24 E., a typical area of Cherokee silt loam has the profile described below. (1) A_1 horizon, 0 to 7 inches, very light grayish-brown structureless or faintly laminated porous silt loam. The color is almost uniform, except that the material contains a few pale rust-brown specks which blend gradually with the surrounding matrix. (2) A_2 horizon, 7 to 12 inches, very porous, very light-gray or almost white laminated silt loam much lighter than the layer above. It contains a few pale rust-colored specks, but the color is fairly uniform. This material is slightly more acid than the layer above. (3) From 12 to 13 inches, a thin transitional gray layer merging with the claypan material. It does not have the smooth feel of the gray layer above; many small clay particles are embedded in the gray material. The lower one-half inch contains larger clay particles than the upper, and the gray material gradually gives way to clay particles. (4) B_1 horizon, 13 to 19 inches, dark grayish-brown or drab extremely dense clay which breaks into irregular sharp-cornered somewhat cubical clods several inches in diameter. The structure particles lie close together and adhere to one another so firmly when moist that they can scarcely be separated. A broken lump, however, indicates by its slightly roughened surface some structural arrangement. The outside of the struc-

tural particles is coated with dark grayish brown. The particles have red and yellow or rust-brown centers. The material as a whole appears rather dark grayish brown or drab. This is the densest layer in the soil. (5) B_2 horizon, 19 to 50 inches, grayish-brown or drab dense clay similar to the layer above but not quite so dense and a shade or two lighter in color. The red and rust-brown specks are decidedly more yellow. A few gypsum crystals were noticed in the lower part of this layer just over the partly weathered shale. (6) C horizon, 50+ inches, bluish-gray partly weathered soft argillaceous platy shale, becoming much harder with depth.

Studies made of Cherokee silt loam under different moisture conditions and at different places brought out some interesting features not noticed in the profile described above. The contact line between the heavy layer and the gray layer is not horizontal but undulates in a rather pronounced way. These undulations range from a few inches to almost a foot within a space of a few feet and without any apparent regularity. Variations are as great on the flat areas as on the sloping lands, but the heavier layer is everywhere better developed on the flat areas. In the upper inch or so of the heavy layer a red tinge can be seen when the layer is dry. This soil is a typical ground-water podsol.

Parsons silt loam differs from Cherokee silt loam in the degree of development and slightly greater pH values of the various layers. The Parsons soil has a darker-colored surface layer, a darker and less laminated A_2 horizon in which the granules are somewhat flattened and coated with a sprinkling of gray, a B_1 horizon or claypan layer similar to that of the Cherokee soil except that it seems to be a little less dense and lighter colored, a B_2 horizon gradually becoming more friable than in the Cherokee soil, and a C horizon similar to that of Cherokee silt loam. The Parsons soil has not been so greatly influenced by slow underdrainage as has Cherokee silt loam.

Neosho silt loam differs from Cherokee silt loam in having a darker-colored and thicker surface layer and an A_2 horizon which is more yellowish than in the Cherokee soil. The claypan of Neosho silt loam is not so dense as that of Cherokee silt loam, but it is more mottled with rust brown and gray. This layer gradually merges into more friable somewhat water-logged material, somewhat stratified and showing water deposition. Neosho silt loam differs from Cherokee silt loam mainly in the density of its claypan. The Neosho soil has developed from alluvium on old terraces and is very similar in surface features to Cherokee silt loam.

The Summit soils, comprising the second group, have dark-colored surface soils and friable subsoils. They have weathered from calcareous shales and occur in isolated areas in all parts of the county, except the southeast corner, on the lower slopes, and positions around stream heads. They are fairly well drained. In a pit one-third mile north of the southwest corner of sec. 19, T. 30 S., R. 24 E., an area of Summit silty clay loam showed the profile described below. (1) A_1 horizon, 0 to 3 inches, very dark grayish-brown structureless or semi-granular silty clay loam in which the granules are very small and poorly defined. This horizon contains much organic matter. (2) A_2 horizon, 3 to 20 inches, a granular layer consisting of friable silty clay loam. The granules are well defined, very small, and have

rounded corners. The color is almost black with a very faint gray sprinkling. (3) B_1 horizon, 20 to 31 inches, granular and moderately compact silty clay loam or silty clay, slightly lighter in color than the layer above. The granules are also a little larger, more angular, and more compact. The material is fairly heavy but not a claypan. The outsides of the granules are very dark gray and the insides are dark gray. When crushed the material is slightly lighter than the broken faces. Ferruginous pellets, from one-sixteenth to one-eighth inch in diameter, are scattered in this layer. The lower part is more or less columnar in breakage. (4) B_2 horizon, 31 to 45 inches, grayish-yellow or olive very faintly granular silty clay or clay of indefinite structure. This layer is moderately compact. The lower part contains lime nodules and gypsum crystals. (5) C horizon, 45+ inches, bluish-gray partly decomposed calcareous shale.

In studies made of Summit silty clay loam under different moisture conditions and at different places some interesting features are shown that were not noticed in the profile just described. The texture varies within a few feet from silt loam to clay in many places. In cultivated fields the soil has dried and cracked, and the cracks have filled with looser material which gives the soil in excavations a latticelike appearance. In other places lime nodules are abundant. The material in these places is not so thoroughly weathered as elsewhere.

Summit silty clay loam, shallow phase, is closely associated with typical Summit silty clay loam. It is underlain either by stratified or loose limerock, and on the surface there are generally scattered thin bluish-gray limestone slabs, usually rounded on the outer edges, which range from 6 inches to several feet in length and from 2 to 4 inches in thickness. Locally the slabs are much thicker. The pH value of the surface soil is generally much higher than in typical Summit silty clay loam. This shallow soil is most extensive in Lincoln Township along the streams. In many places the soil has been removed, leaving only the rock outcrop.

Summit silty clay loam, slope phase, differs from Summit silty clay loam mainly in its less-advanced stage of development as a result of surface features. It occurs on steep slopes, usually beneath higher-lying outcropping limestone. It has developed from soft calcareous bluish shale, and is generally mixed with unweathered or partly weathered parent material.

Summit stony silty clay differs from Summit silty clay loam in its higher rock content. The soil covering the limerock is very thin and in places the bare rock is exposed.

Soils of the third group, which includes members of the Labette and Newtonia series, have friable subsoils and are very closely associated with the Summit soils. They occur in small isolated areas within an ill-defined belt running diagonally across the county in a northeast-southwest direction. The areas of Labette silt loam occur for the most part within areas of the Summit and Parsons soils. In a pit 3½ miles southwest of Farlington a profile of Labette silt loam showed the following layers: (1) A_1 horizon, 0 to 3 inches, a very dark-brown finely granular silt loam in which the granules are very soft and angular, with rounded corners. The material is uniformly dark colored, and the upper part of the layer shows faint

laminations. (2) A_2 horizon, 3 to 10 inches, a dark-brown softly granular silt loam in which the granules are larger than in the A_1 horizon. The granules are very definite in outline, are moderately firm, and show sprinkling of faint gray color. (3) B_1 horizon, 10 to 30 inches, a dark-brown granular silt clay loam in which the granules are lighter in color and a little firmer than in the layer above. This layer, however, is not firm enough to be classed as a claypan. The organic coating which gives the dark color becomes thinner with depth. The insides of the particles are red or light rust brown and the outsides are yellowish red. The clay content increases with depth. (4) B_2 horizon, 30 to 50 inches, a grayish rust-brown silty clay or clay loam, in which the structure particles are small and angular and ferruginous pellets are numerous. The coating on the particles is very thin and is mostly colloidal. The insides of the particles are rust brown or red, with scattered small black specks, and the outsides are pale yellowish brown. In places these particles show some dark organic stains. Organic matter occurs only along root channels and large cracks or animal-formed cavities. (5) C horizon, 50+inches, soft bluish-gray shale.

There are a few variations in Labette silt loam. In places, cherty fragments are numerous; in other places the B horizon is heavy and the soil resembles Parsons silt loam in its principal characteristics. Limestone fragments are common in places.

Newtonia silt loam resembles Labette silt loam in general appearance, but the dark-colored surface layer generally is not so thick and the granular layer is not so well developed, as the granules are softer and less well defined. The organic coating that gives the dark color is also thinner. The B horizon is brownish red and is less dense, and in many places there is no definite accumulation of finer material. The lower part of the B or the upper part of the C horizon is dull red rather than mottled yellow, red, and black as in the Labette soil. The parent material is limestone. The pH value of the surface horizon is slightly higher, but there is no noticeable difference in the lower horizons.

Newtonia silt loam, shallow phase, is closely associated with typical Newtonia silt loam. The corresponding layers are thinner, but the structure and texture are very similar. The color is generally more nearly red. This shallow soil is underlain by stratified or loose limerock and in most places there is on the surface a scattering of reddish-brown thin limestone slabs, usually rounded on their outer edges, measuring from 6 inches to several feet in length and from 2 to 4 inches in thickness. This phase of soil is most extensive in Lincoln and Sherman Townships.

Newtonia silt loam, eroded phase, closely resembles Newtonia silt loam, differing mainly in the color of the surface horizon. It occurs only in cultivated fields or on slopes where the dark-colored surface soil has been removed.

The fourth group includes three soils of the Bates series. These soils closely resemble one another in all characteristics except in the texture of the surface soil and the depth of weathering. Odd-shaped areas occur southeast of Pittsburg and northwest of Brazilton. The following description of Bates loam is of a profile exam-

ined in a pit one-half mile east of the northwest corner of sec. 5, T. 28 S., R. 25 E.: (1) A_1 horizon, 0 to 2 inches, dark grayish-brown loam forming a structureless mulch. (2) A_2 horizon, 2 to 6 inches, very dark grayish-brown structureless or imperfectly granular loam which shows considerable evidence of insect action. When crushed it appears slightly lighter than the broken face. The color is uniform. (3) A_3 horizon, 6 to 12 inches, very dark grayish-brown loam slightly lighter than the layer above. It is very faintly granular, the granules appearing to be owing to insect action. (4) B_1 horizon, 12 to 22 inches, light rust-brown sandy clay loam containing small cube-shaped particles, the centers of which appear to be light rust brown and the outer layer reddish brown, with yellowish gray between the two. Colors, however, are so blended and granulation so imperfectly developed that color distribution can not accurately be determined. The material crushes to yellowish brown, indicating that the rust shades dominate. (5) B_2 horizon, 22 to 36 inches, yellowish-brown moderately compact, coarsely granular clay loam. The insides of the structural units are red and the outsides are thickly coated with grayish brown. The material contains sufficient clay to smear between the fingers. When crushed, it is mottled red and grayish brown, the grayish brown dominating. (6) B_3 horizon, 36 to 60 inches, gray or rust-brown silty clay containing some soft black pellets having pale-gray exteriors and black interiors. The material is probably a little lighter and very much more raw than that above. This layer grades into unweathered very fine sandy shale.

Bates very fine sandy loam differs from Bates loam mainly in texture. The organic-matter content is greater and the particles are larger in the loam than in the very fine sandy loam. The very fine sandy loam has weathered a little deeper than has the loam. The position and pH values of the two soils are about the same.

Bates silt loam differs from Bates loam in the texture and color of the surface horizon and in the depth of weathering. This soil is yellowish brown, contains more organic matter, and shows a slightly better-developed structure than the loam. The A_2 horizon shows a sprinkling of gray, is more definitely granular, and is much thicker. The B horizon is somewhat more compact and its color and structure are much more definite. The C horizon is similar to that of Bates loam. The pH values of the two soils are very similar.

In the fifth group are the alluvial soils, including members of the Verdigris and Lightning series. These soils occur along the larger stream bottoms of the county. A sample of Lightning silty clay loam taken from a pit 50 feet east of Lightning Creek on the south side of sec. 19, T. 30 S., R. 23 E., showed the following layers: (1) 0 to 4 inches, grayish-brown structureless or semilaminated silty clay loam; (2) 4 to 10 inches, light-gray semigranular silty clay loam containing a few brownish specks, which when crushed is somewhat darker. (3) 10 to 16 inches, more pronounced gray silty clay loam containing rust-brown specks a little larger than in the layer above, which when crushed is about the same color as the broken face; (4) 16 to 24 inches, light grayish-yellow silty clay loam, lighter gray and more rust brown than the layer above, the gray apparently consisting of finer material than the rust brown; (5) 24 to 27 inches, bluish-gray, specked with brown and light gray,

silty clay a little heavier than the layer above, containing more dark organic infiltrations, and becoming more yellow with depth; (6) 27 to 38 inches, light-brown clay mottled pale yellow and gray and much heavier than the layer above. The material is very raw and has a bluish cast near organic infiltrations.

Verdigris silt loam closely resembles Lightning silty clay loam in its textural profile. The color is uniform dark brown or brown. The surface soil has a little higher pH value than that of the Lightning soil. The second layer is a little lighter in color but the color is uniform, whereas the corresponding layer of Lightning silty clay loam is highly mottled. The lower part of the Verdigris soil is light grayish-brown silty clay loam stained with a few rust-brown streaks along old root channels. This type has developed under fairly good drainage, as compared with the Lightning soil.

Table 5 shows the pH values of some Crawford County soils, as determined by E. H. Bailey, of the Bureau of Chemistry and Soils. Determinations were by the electrometric method, using the hydrogen electrode.

TABLE 5.—*pH values of Crawford County (Kans.) soils*

Soil type	Depth in inches	pH	Soil type	Depth in inches	pH
Parsons silt loam	0–3	5.80	Newtonia silt loam	34–37	5.51
Do	7–11	5.24	Do	42–45	5.55
Do	16–19	5.62	Cherokee silt loam	0–7	5.46
Do	34–37	6.32	Do	7–12	5.08
Newtonia silt loam	0–3	4.50	Do	12–19	4.59
Do	16–19	5.26	Do	19–40	5.05

Table 6 shows the chemical composition of Cherokee silt loam in Cherokee County, Kans.

TABLE 6.—*Chemical composition of Cherokee silt loam in Cherokee County, Kans.*

Sample No.	SiO_2	TiO_2	Fe_2O_3	Al_2O_3	MnO	CaO	MgO
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
27890 (surface soil)	86.96	0.69	2.86	4.69	0.07	0.71	0.43
27891 (subsurface soil)	85.13	.74	3.49	5.84	.09	.65	.49
27892 (upper subsoil)	69.30	.74	4.65	15.06	.02	.77	1.07
27893 (lower subsoil)	67.82	.72	4.86	16.74	.02	.80	1.14

Sample No.	K_2O	Na_2O	P_2O_5	SO_3	N	Ignition loss	C
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
27890 (surface soil)	0.91	1.07	0.07	0.08	0.113	2.96	1.15
27891 (subsurface soil)	1.00	1.16	.07	.07	.09	2.40	.65
27892 (upper subsoil)	1.20	1.10	.10	.18	.134	6.90	.91
27893 (lower subsoil)	1.11	1.04	.11	.23	.089	5.19	.55

SUMMARY

Crawford County is in the southeastern part of Kansas. It comprises 590 square miles or 377,600 acres. Physiographically, the

county is part of a plain which has been dissected only slightly. The greater part of the land is level or undulating, with a few winding ridges.

In 1920, the county had an urban population of 27,135 and a rural population of 34,665. Pittsburg, the largest town, had a population of 18,052. The coal-mining industry has brought a large foreign population into the region. Only about 60 per cent of the people are of native-white parentage.

The climate of Crawford County is characterized by wide seasonal variations. The greater part of the annual rainfall comes during the growing season. Hot winds in late summer may damage growing crops.

Corn, wheat, oats, sorghums, alfalfa, and prairie hay are the principal crops. Corn was the most important crop until 1915, when wheat temporarily surpassed it in acreage. The other crops mentioned are of minor importance.

About 90 per cent of the land of Crawford County is tillable. In agricultural adaptations the soils of the county may be grouped in two principal groups, the Cherokee and the Summit. Soils of the Summit group cover about 25 per cent of the total area of the county and of the Cherokee group the greater part of the remainder.

The soils in the Cherokee group have light-colored surface layers and dense heavy claypan subsoils. The heavy claypan subsoil retards drainage in the soils, and plant roots do not penetrate the claypan and reach the moisture below. For this and other reasons these soils are better suited to the short-rooted crops such as wheat and other small grains. Corn is grown to some extent, but yields are uncertain. The sorghums are more successful, because of their ability to withstand drought. Cherokee silt loam is the least productive of these soils. It occurs on nearly flat areas. Neosho silt loam, occurring on the river terraces, is similar to Cherokee silt loam but its position gives it slightly better drainage. Parsons silt loam has a slightly darker surface soil, indicating a higher content of organic matter. This soil occurs on gentle slopes and is better drained.

The soils of the Summit group have dark-colored surface layers rich in organic matter and heavy but moderately friable subsoils. Deep-rooted crops, such as corn, produce well on these soils. Wheat and other small grains do well, but the need for corn is so great that 85 per cent of the area of these soils is devoted to that crop. Summit silty clay loam is the principal soil in this group. Summit stony silty clay is a minor soil of this series. The Summit soils have weathered from fine shales. Labette silt loam differs from Summit silty clay loam in having a browner or redder subsoil. Newtonia silt loam has a brown or reddish subsoil and has weathered from limestone. Verdigris silt loam is a dark-colored very productive soil occurring in stream bottoms. All crops grown in the county do well on this soil if they are not injured by floods. Bates silt loam and Bates very fine sandy loam have dark-colored surface soils and brown friable subsoils. They are derived from and overlie sandstones. Lightning silty clay loam is a light-colored stream-bottom soil having poor drainage. Only a small part of it is cultivated.

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[PUBLIC RESOLUTION—NO. 9]

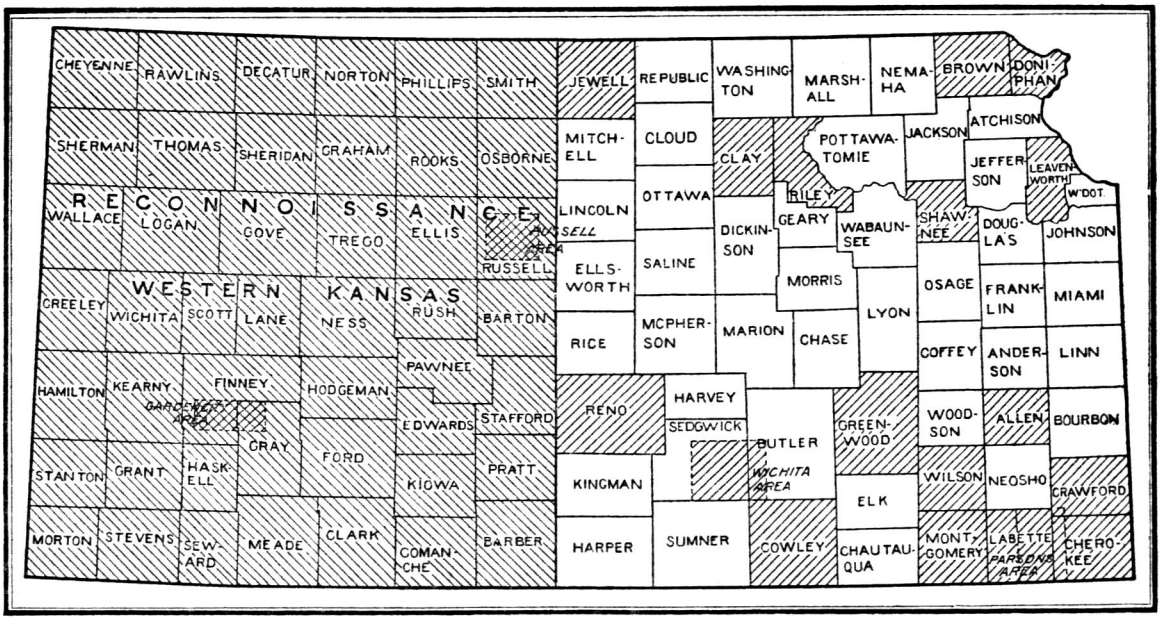
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]



Areas surveyed in Kansas, shown by shading

U. S. GOVERNMENT PRINTING OFFICE: 1931

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