SOIL SURVEY OF CEDAR COUNTY, MISSOURI.

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DESCRIPTION OF THE AREA.

Cedar County lies in the southwestern part of Missouri, on the borders of the Ozark region. It is the second county east from the Kansas state line and the fourth county north from the Arkansas state line. It is bounded on the north by St. Clair County, on the

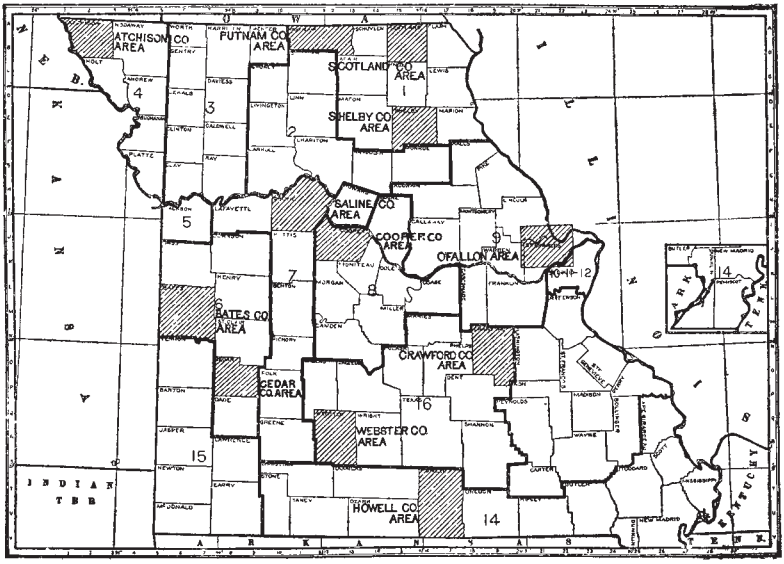

FIG. 43.—Sketch map showing location of the Cedar County area, Missouri.

east by St. Clair and Polk counties, on the south by Dade County, on the west by Barton and Vernon counties. It is included within parallels 37° 35′ and 37° 55′ north latitude and meridians 93° 36′ and 94° 4′ west longitude. The county contains 318,720 acres, or about 498 square miles.

The fundamental feature of the topography is a plain with a gentle slope to the northwestward. At the southeastern corner of the county it lies at an elevation of approximately 1,040 feet above sea level, and at the northwestern corner, where it is lowest, at an elevation of 860 feet above the same datum. It exists at the present time not as an

unbroken or unmodified unit, but only in fragments, having been cut into pieces by the erosive action of a great number of streams which flow across it.

The topography in detail is an expression of the variety of form produced by a great number of streams of varying sizes and varying numbers per square mile, eroding valleys into a sloping plain underlaid by rocks that vary in resistance to erosion not only from place to place, but also in the same place at varying depths.

Across the county in a north-south direction lies the valley of Sac River and into it from the southwest on the one hand and the southeast on the other open a large number of tributary valleys. Each of these in turn has a number of tributaries which themselves subdivide, so that the final result is a rather intricate network of valleys, large and small, covering the county. The streams occupying these valleys have, in cutting them, broken the continuity of the upland plain. The completeness of the dissection, or, in other words, the number of valleys per square mile, varies from place to place. In general that part of the county east of Sac River is much more completely cut to pieces or dissected than that part lying west of that stream. There is a large number of streams whose size warrants their description as main tributaries, and these in turn have a larger number of small tributaries. In short, practically the whole area of the county east of Sac River is completely dissected.

The eastern half of the county is rougher, not only on account of the greater number of valleys and the more thorough dissection resulting therefrom, but also because of the greater depth of the valleys. The upland stands higher than in the western half and the streams on both sides have adjusted their grades to the same datum—the flood plain of Sac River. The valleys are deeper, therefore, and there are more of them. There are only a few small areas of smooth upland in the eastern half of the county.

In the western half of the county, on the other hand, there are large areas in which valleys are few in number and so shallow that the country is merely rolling. It is only along the larger streams that areas occur so completely dissected that they should be described as rough. Even in these areas the valleys are shallow, rarely reaching a hundred feet in depth. There are considerable areas, therefore, in the western half of the county that consist of smooth to undulating or at most rolling plain, while the rougher areas are merely hilly. The smoother areas are prairie areas or have a very scant growth of blackjack trees.

In the western part of the county the valleys are wide, open troughs. The slopes are usually gentle and the depth rarely exceeds 100 feet. Only along the larger streams do steep slopes occur. The

rocks into which the valleys are cut are soft, so that steep slopes can not persist for any considerable length of time.

Eastward the rocks rise. Beneath the soft rocks of the western part of the county are hard limestones, too deep to be reached by the streams, but the eastward rise soon brings them near enough the surface to be cut as the valleys are dissected, the large streams reaching them farthest west. The continued eastward rise makes it necessary for the streams not merely to cut down to them, but to cut into them. Downstream, therefore, below where the hard rocks are first encountered, the lower slopes of the valleys, that part made by cutting into the hard rock, are steep, while above the top of the hard rock there is a more gradual rise to the upland level. In the eastern part of the county the soft rock exists only in small areas on the tops of the high uplands and as a very thin cap. The valleys, therefore, are cut almost entirely in the harder rock and their slopes are steeper than those in the western part of the county.

The width of the valleys is a function of the size of the stream and of the character of the rock. Streams of the same size have wider valleys in the western part of the county than in the eastern. No large streams occur, however, in the extreme western part of the county. By the time the eastward-flowing streams on this side have become equal in size to the larger creeks east of Sac River they are far enough east and have cut deep enough to reach the hard rocks.

The broadest valley is that of the Sac River. It is much larger than any of the other streams and has been able to accomplish much more work. The width of the valleys is shown by the belts of alluvial soil on the accompanying map, and need no further discussion here.

The drainage plan is very simple. The whole area of the county, except a few square miles in the extreme northwestern corner, is drained by Sac River and its tributaries, all of which join it at normal angles and spread their branches out through their several drainage basins in the normal dendritic fashion. The names of the streams, their relative size, and their location may be seen by consulting the accompanying soil map.

The county abounds with springs, many of them of large size and perennial. The water from the springs in the limestone areas of the county is clear and contains considerable lime in solution, making it hard. The water from the springs in the sandstone region contains large quantities of iron in solution, usually in the form of carbonates. On exposure to the air it soon becomes yellow, due to the precipitated iron. The springs at Eldorado Springs have been exploited as medicinal and have attained quite a reputation.

The first settlers came to Cedar County in 1830 and settled in the southeastern part of the county. For the next fifteen years the

settlement was confined to the eastern part of the county near where Cane Hill and Stockton now stand. By 1845 the number of settlers had increased sufficiently to justify the separation of Cedar County from Dade County. The first settler to enter land on the prairie east of Jerico Springs was in 1854, and from that time up to the outbreak of the civil war the settlement was very rapid all over the county. Tennessee furnished 90 per cent of these early settlers. In the nineties some Germans settled near Jerico Springs, and about the same time a few Bohemians settled a little farther north. Within the last twenty years a good many farmers from Illinois have bought land around Eldorado Springs. The present population of about 17,500 is almost entirely engaged in agriculture.

Stockton, located a little southeast of the center of the county, is the oldest town and the county seat. It was founded in 1846 and has a population of about 700. Eldorado Springs, in the northwestern part of the county, was founded in 1881 and has a population of about 2,800. Court is held here half of the time. Jerico Springs, in the southwestern part of the county, has a population of 500. Many very small villages and country crossroads stores are scattered over the county.

The transportation facilities of the county are not the best. Eldorado Springs is the only town having a railroad—a spur leading from the main line of the Missouri, Kansas and Texas Railway. This provides access for the northwest corner of the county to the markets of Kansas City and St. Louis. The remainder of the county is not so fortunate. Much of the marketing around Jerico Springs is done at Lamar, in Barton County, 18 miles southwest. Lamar has two railroads, the Missouri Pacific and the Kansas City, Fort Scott and Memphis. The eastern part of the county is served by the Kansas City, Clinton and Springfield Railway, which passes about 3 miles from the eastern county line, and has a number of shipping points located on it.

Besides the lack of railroad facilities, the wagon roads are ill kept and many of them are either stony or sandy. Where they traverse the limestone soils, the surface has been eroded away and the track lies on the broken chert fragments. Sandstone also appears in the road in much of the area covered by the Cherokee formation. In addition there are the usual problems associated with road building in a rolling country, and the old system of working out the road tax has not been very successful in solving them. However, additional levies have just been made and a start taken toward a steady improvement of the highways. The limestone and chert found in such abundance would furnish the best of material for the construction of permanent roads. Both limestone and sandstone suitable for building purposes are very abundant.

Kansas City and St. Louis are the markets for live stock, poultry, and wheat, which are practically the only products sent out of the county.

CLIMATE.

The climate of Cedar County is that of a mid-continent region, with its great extremes of temperature, but there are a large number of clear, pleasant days. The winters are not extremely cold. The growing season is long enough and warm enough for maximum production of corn, though not for cotton. The accompanying table gives the normal monthly, seasonal, and annual temperature and precipitation at Lamar, in the adjoining county of Barton. From this it will be seen that the mean temperature of the summer months is 76° F. and of the winter months 34° F. The annual precipitation is ample, averaging 41.1 inches, and not falling below 28.1 inches for the driest year. The rainfall is well distributed, every month getting some rain, but the least precipitation occurs during the winter months. The six growing months, April to September, inclusive, have an average rainfall of 26.8 inches.

Normal monthly, seasonal, and annual temperature and precipitation at Lamar, Barton County.

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	71	−10	2.2	2.0	2.1	2.3
January	32	75	−14	1.5	1.2	0.7	3.9
February	34	72	−25	2.5	0.7	2.3	5.6
Winter	34	.....	.....	6.2	3.9	5.1	11.8
March	45	84	1	3.0	4.9	4.2	2.0
April	58	91	22	4.0	2.0	2.5	Trace.
May	66	93	29	5.6	2.4	8.0	0.0
Spring	56	.....	.....	12.6	9.3	14.7	2.0
June	74	102	41	4.7	1.0	8.3	0.0
July	78	108	50	4.1	2.0	2.4	0.0
August	77	104	48	4.0	3.5	8.5	0.0
Summer	76	.....	.....	12.8	6.5	19.2	0.0
September	70	104	33	4.4	4.9	8.7	0.0
October	59	96	27	2.9	1.9	1.9	Trace.
November	46	80	8	2.2	1.6	4.5	0.3
Fall	58	.....	.....	9.5	8.4	15.1	0.3
Year	56	108	−25	41.1	28.1	54.1	14.1

Average date of last killing frost, April 14; average date of first killing frost, October 18.

AGRICULTURE.

The early settlers found, according to reports, about three-fifths of the county covered with timber. Deer, turkey, and smaller game were plentiful and furnished much of their food. A field on the bottoms was cleared for corn and stock was grown on the range. No railroads were near and the only marketable products were the cattle, sheep, hogs, and horses, which were driven to Jefferson City or St. Louis.

Very little of the original timber in the county found its way to the outside markets, owing principally to the lack of shipping facilities. Small sawmills have cut some for local consumption, but the most valuable timber, which was found on the bottoms, was cleared off at an early date to make room for crops. Some of the remaining walnut was cut and hauled out about thirty years ago.

During the period from 1860 to 1865 everything came to a standstill, for the county was the seat of considerable guerrilla warfare, but at the cessation of hostilities agriculture began immediately to revive. The building in 1870 of the Missouri, Kansas and Texas Railway, which passed within a few miles of the county on the west, inaugurated a new era. Wheat could be raised for shipment, some of the soils being especially well suited to the crop, and other farm products could also be marketed to greater advantage. Soon after the advent of the railroad the farmers began to fence the range, but it was not entirely fenced until 1885. Since that time agriculture has had a steady growth, without any very great changes in the progress. The live-stock industry has continued to predominate to the present day. According to the census of 1900 only 31 per cent of the total area of the county was under the plow, while 59 per cent is reported as improved farm land. Of the plowed land 70 per cent was devoted to corn, 14 per cent to wheat, 10 per cent to oats, and nearly 3 per cent to forage crops, all of which, except the wheat, was fed to stock, since none was sent out of the county. Twenty-eight per cent of the improved land was in mowing land and pasture land. The grazing area is increased also by the 41 per cent of unimproved land, which, though in timber, is to a great extent used for pasture. These figures are generally applicable at the present time, although it is probable that the acreage of wheat has increased somewhat at the expense of corn.

Cattle range on the large pastures until grown, when they are fattened on corn for market. In years of corn shortage many feeders are sent out, while in years of abundant corn feeders are brought in and fattened. Shorthorns largely predominate and the grade on the whole is very fair. Several small herds of pure-bred shorthorns are found in the county and these supply the local demand for bulls. There is one very good herd of Herefords in the county.

Hogs are next in importance and great numbers are raised, fattened, and sold. Grades of Duroc Jerseys and Poland-China predominate. The horses are almost entirely of the light-harness class and some of them are quite good. The Germans have some heavier horses and a few are found elsewhere in the county.

The following figures will give some idea of the number of stock in the county and the number fattened and sent out each year. On an average a carload of stock leaves Eldorado Springs each day of the year, and this is only a minor part of the stock shipped out of the county. The assessor's returns for 1908 give the number of stock in the county as follows: Cattle, 17,135; hogs, 29,323; horses, 7,301; mules and asses, 2,392; sheep, 7,377.

The poultry industry is also extensive, but it was impossible to obtain any exact data, because the great bulk of the poultry is shipped from points outside the county. There are no great breeding or feeding establishments in the area, but large flocks are found on nearly every farm. Great quantities of eggs are sent out, and in the fall large numbers of chickens are marketed, both alive and dressed. From November until January the turkeys are collected in great droves and driven to market.

Of the crops not grown for stock feed, wheat is the leading one. The local flour mills, of which there are eight in the county, buy what they can use and the surplus finds its way to the large outside markets. The local mills supply practically all of the flour used in the county, but none is exported. The by-products of milling find a ready market with the stockmen.

Sorghum is one of the minor crops receiving considerable attention. Some of it is grown for the manufacture of sirup, of which a very good grade is made. The production supplies the home demand, and in the neighborhood of Eldorado Springs some is produced for shipment. Sorghum is found to do best and to make the best grade of sirup when grown on the Bates loam. Five carloads were shipped from Eldorado Springs during the present season. The price received was 39 cents a gallon. Probably two-thirds of the acreage of sorghum is grown for stock feed. In this case it is sown thick and when properly matured is cut with a mower or binder and cured in the field, where it is kept until needed. It makes a large quantity of feed which is growing in favor with the farmers. It does well on all soils, but produces best on the limestone soils and the bottom lands. A small amount of kafir corn is also produced.

Around Eldorado Springs, owing to the better shipping facilities, agriculture has taken a form somewhat different from that found over the greater part of the county. Here a number of commercial apple and peach orchards have been set out, and during favorable years considerable surplus fruit is shipped. For the last three or

four years, however, late spring frosts have destroyed the crops. The orchards are located on the Bates clay loam and the Bates loam, but it seems certain that the limestone soils would be better suited to apples. Some potatoes and strawberries are also grown in this section and shipped from Eldorado Springs. On the sandy lands near Jerico Springs the farmers produce large quantities of watermelons and muskmelons of good quality.

According to the census of 1900, 88 per cent of the county is in farms, 59 per cent being reported as improved lands. While there are no very large ranches in the area, several contain from 600 to 1,000 acres. These are invariably stock farms. The average size of the farms is 101 acres. Forty-eight per cent of the farms are operated by the owners, and there are no class distinctions between the landlord and the tenant. The tenants on the leased farms pay in grain, one-third or two-fifths of the crop being the usual rent. Pasture for a limited number of stock is usually free. When pasture is rented, the usual rate is $1 a month per animal. The average value of farm land in the county is $20, while $50 is the top price, except in extreme cases. Farm labor is satisfactory, but hard to obtain. It consists of native whites, there being no foreign laborers in the county, and only three families of negroes. The monthly wage ranges from $15 to $20, with board.

The fences in the county were originally rail, but later a great number of Osage orange, or bois d'arc, hedges were set out. At present barb-wire and woven-wire fences have nearly replaced the old rail fences. Owing to the permanent nature of the hedges they still remain, but are almost always poorly kept and overgrown, being allowed to take up entirely too much room. However, from these old hedges, when they have attained sufficient size, the most valuable fence posts are made, for an Osage orange post is practically indestructible.

At present there is little valuable timber standing, yet some is being sawed for local consumption. The great bulk of this is small and of little use except for fuel and posts. Since the settlement of the county the trees have showed a decided tendency to spread over the limestone land that was previously prairie, but on the sandstone land they do not spread beyond their original limits.

Great quantities of stone have been cleared off the farms, but in many fields enough still remains to hinder seriously the use of farm machinery. This is especially true of the cherty limestone soils. The farmers are very negligent about protecting their farm machinery, as binders, plows, cultivators, etc., are frequently left in the field where last used until wanted again. Much of the machinery, too, is antiquated. This circumstance is partly due to the stony condition of much of the land. The farm buildings, taking the country

as a whole, show only a fair degree of prosperity. Although many neat, well-kept farmsteads are seen, there are also numbers of houses and barns built of logs, many of which are in a poor state of repair.

The wild grasses that covered the prairies were found so valuable that in many cases they have been preserved after the range has been fenced into pastures. There are a number of large pastures and numerous smaller ones that have never been plowed. It is often stated that prairie grasses if once killed out will not reappear, but this is not true, at least on the limestone soils. Cases are on record where by judicious care the bluestem, which had been practically killed out by close pasturing, has taken possession of the land in a few years and has yielded as good crops as formerly. When used for mowing it is not best to cut two crops a year, as some farmers do, for this practice tends to kill it out. When pastured too short, weeds appear. If pastures are properly managed the "broom grass" or broom sedge (*Andropogon virginicus*), so much dreaded by the farmers, will not get into them. This grass appeared in abundance in the county ten or twelve years ago. It is very troublesome, especially on the sandstone soils, getting into mowing land and pastures. Stock will not eat it, except in its younger stages. Japan clover (*Lespedeza striata*) is reported to have been in the county only about five years, but it has spread everywhere along the roadsides and seems to be adapted to all soils. It is readily eaten by stock, and at least one man has made hay of it, securing three-fourths ton to the acre. Being a legume it is considered a valuable addition to the indigenous flora.

Alfalfa has been tried by a number of farmers and many failures are reported. However, a number of small fields are doing well. These are located either on the Osage silty clay loam, Osage fine sandy loam, or the Decatur soils; that is, they are found on the bottom lands that have good drainage or on the red limestone uplands. None is found on the soils of the Bates or Boone series, and it is probable that alfalfa will not thrive on these sandstone soils. To secure a stand, the field when seeded should be inoculated with soil from an old alfalfa field to insure the presence of the alfalfa bacterium.

The natural drainage in the county is good, except in the small areas of Guthrie silt loam and in some of the bottom lands. Farmers are just beginning to use tile in these places, and undoubtedly this will be found very profitable.

Suggestions for the betterment of the agriculture of the county lie along lines of more attention to the details of good farming rather than in any radical change in farm management. It seems eminently proper that the live-stock industry should predominate and that the management of the farms should center around stock raising. The county is suited by climate, soils, topography, and range of

products to this industry, and the people are to be congratulated on the advances already made in this direction. But there is room for improvement in the grade of stock kept. The average weight of the horses of the county is not over 1,100 pounds, with a predominance of standard blood. By a larger infusion of draft blood the weight could be very profitably increased to 1,400 pounds, but extreme weight in the horses is not advisable in this county on account of the hilly and stony nature of most of the farms. A still better grade of beef cattle should be kept. Many farmers are satisfied with grade bulls, while only pure-bred bulls should be used. The number of sheep could be very profitably increased. The grade of hogs is not the best. Only pure-bred boars should be used. Either one of the breeds of pure-bred hogs now found in the county is well suited to the conditions.

At present the dairy industry is practically undeveloped, and it should receive more attention. If the labor question connected with milking and caring for the cows can be solved, which seems very probable, there should be great possibilities along this line. The great number of Shorthorn grades would make an excellent foundation for dairy herds, and if they were mated with bulls from dairy strains of the Shorthorn breed fine dual-purpose herds could be built up. The limestone soils are especially well suited to dairying; the grasses are plentiful and nutritious, grains and supplementary feeds are available, the winters are not severe, and the finished product, butter, can be put on the market very cheaply. The Rough stony land and the rougher parts of the stony loam soils can find no better use than to be put in permanent pasture. Alsike clover will probably do well on the sandy soils. It is worthy of trial at least.

The large numbers of stock kept produce a great deal of manure which should be more carefully saved and applied to the cultivated fields. Experience in this county has shown what science has demonstrated elsewhere, that there is nothing equal to barnyard manure for restoring the lessened productivity of the soils. Crop rotation should be more faithfully practiced. The tendency has been for the farmers to follow the one-crop system, especially in case of corn on the land best suited to it. The Germans who came to the county about 1895 raised the standard of agricultural practices in their neighborhood. They began to rotate crops and to grow more legumes. Clover is the principal legume for the limestone soils and cowpeas for the sandstone soils. Strict attention given to rotation, including legumes, the use of all available barnyard manure, and clean culture of the fields will lessen the need of artificial fertilizers, with the exception of lime, which is probably required on most areas of the sandstone soils.

SOILS.

Cedar County lies along the border between the Ozark Uplift, which stretches away to the south and east, and the region of residual prairies. The soils are thus varied in character. They belong mainly to the groups known as the " soils of the Limestone Valleys and Uplands " and the " Residual Soils of the Western Prairies," though the River Flood Plains Province is also represented by the types mapped in the Osage series.

The prairie region soils include the Bates, Boone, and Oswego series, which have been formed by the weathering of the Cherokee formation of the Lower Coal Measures. These strata consist of sandstones, shales, and shaly sandstones. The sandstones are usually brown but occasionally yellow or gray and when weathered are often quite soft. They are cemented with iron oxide and weather into a fine sand. Occasionally concretionary ironstones are found. The shales and shaly sandstones are interbedded with the sandstones and the different resulting soils owe their distinctive features to differences in the strata from which the materials forming them have been derived. The shale that produced the Oswego silt loam is a blue argillaceous shale containing no sand, lying at the very base of the Cherokee formation.

The Cherokee formation at one time covered the whole county, but has since been eroded away over large areas, exposing the underlying formations. At the present time it occurs in the western part of the county and on the higher portions of the eastern part. Next below the Cherokee is found the Burlington in the valleys of the western part of the county and over large areas of valley and upland in the central and eastern part.

The Burlington limestone has produced the soils of the Clarksville, Decatur, Wagoner, Eldorado, and Guthrie series. It is a gray coarse-grained pure lime carbonate. Interbedded with the limestone is a great deal of chert. The latter has persisted in the weathering of the limestone and now appears as loose stone in most of the soils. It is usually most abundant on rather steep slopes where the finer parts of the soil have been washed out, allowing the stone to accumulate, where it forms the Clarksville stony loam. It is also found in considerable quantities over wide areas in the extensive Eldorado stony loam type and the Decatur stony silt loam. It is almost lacking in the Guthrie silt loam and the Decatur silt loam. Most of this chert shows the effects of long weathering by its porous condition.

Along the Sac River and a few of its tributaries, erosion has cut down to the Hannibal sandstone and shale. The shale has given rise to the Hannibal silt loam, which is found in small valleys and nar-

row strips along these streams. Still lower than this there are a few exposures of Chouteau limestone, but they have produced no soil, or at least none was distinguishable from the surrounding soils. The lowest stratum recognized is the so-called "Magnesian" limestone, which is of undetermined age but quite old, possibly Cambrian. In a few places bordering the Sac River some soil has been produced from this limestone, but as it has the same physical characteristics and agricultural value as the Eldorado stony loam it was included with this soil.

Alluvial soils are found along all the large streams of the county. They are of quite recent origin and have been formed from reworked materials from all the various soils of the county. They are placed in the Osage series.

Besides the agricultural soils there have been found in various parts of the county small areas of land too rough or stony for profitable cultivation. These may be derived from any of the geological formations described and have been mapped as Rough stony land.

Sixteen soil types have been recognized and mapped in the county. The following table shows the actual and relative extent of each:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Bates loam	70,528	22.1	Osage silt loam	10,816	3.4
Wagoner stony silt loam	41,984	13.2	Boone stony loam	10,432	3.3
Eldorado stony loam	9,920	8.8	Clarksville stony loam	8,320	3.0
Gray phase	18,304		Flat phase	1,152	
Rough stony land	26,880	8.3	Hannibal silt loam	9,088	2.9
Boone fine sandy loam	25,728	8.1	Oswego silt loam	7,744	2.5
Bates clay loam	24,344	8.0	Decatur silt loam	4,224	1.3
Osage silty clay loam	20,416	6.4	Guthrie silt loam	448	.1
Decatur stony silt loam	15,872	5.0			
Osage fine sandy loam	11,520	3.6	Total	318,720	

BATES CLAY LOAM.

The soil of the Bates clay loam is a brown loam from 10 to 15 inches deep. The subsoil is a dark-gray or dull-yellow loamy clay mottled with reddish brown. A small amount of sandstone fragments may be found in both soil and subsoil, and the partially weathered sandstone in place is often found at depths of 3 to 6 feet.

This soil is usually well drained, quite friable, and easy to cultivate. It is found in the western part of the county in large areas. The topography is level to gently rolling. It is variously situated in regard to topography and to the other soils, owing to the effects

produced by the erosion of the interbedded shale and sandstone beds of the Cherokee formation from which it is derived. It is found on the flat tops of divides and bordered with the Bates loam; also in flat saucer-shaped valleys, both small and large, that have been formed by the weathering of shale beds. The loam may extend to the top of the ridge surrounding this valley, or the ridge may be sandy loam or in places a stony loam. A few small areas have been mapped as Bates clay loam that are evidently a mixture of the soil from the Cherokee formation with the soil from the underlying limestone of the Burlington formation.

The Bates clay loam is usually prairie, but occasionally it is covered with a growth of black-jack, post, and black oak. In such places it is lighter in color than the prairie type, the surface soil is only 6 to 8 inches deep, and the subsoil is yellow. Near Virgil City a phase is found in which the soil is gray and only 4 to 8 inches deep. This area is prairie and nearly level.

Although this is a soil of moderate productiveness it is almost all farmed. All the staple crops are grown and no attempt is made to grow special crops. Corn yields from 10 to 40 bushels, averaging, under good management, 25 bushels. Wheat does fairly well, averaging only about 12 bushels. Timothy will produce from one-half to 1 ton of hay per acre. Red clover does poorly and bluegrass is seldom grown. Cowpeas do very well and should be depended upon to build up this soil. Apples, peaches, and small fruits do well.

The Bates clay loam responds very promptly to applications of stable manure. A few farmers have applied lime to this soil with favorable results. Other fertilizer applications have been so haphazard that no definite conclusions can be drawn. It seems probable that with cowpeas, lime, and stable manure the productiveness of the soil can be raised to such a high degree that the use of commercial fertilizers would not be found profitable. This soil is valued at $20 to $30 an acre and in the immediate neighborhood of Eldorado Springs somewhat higher.

The following table gives the average results of mechanical analyses of the soil and subsoil of the Bates clay loam:

Mechanical analyses of Bates clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21408, 21934.....	Soil.....	0.9	2.1	2.1	14.4	9.0	70.3	20.9
21409, 21935.....	Subsoil.....	1.0	1.5	1.7	12.8	7.9	37.0	38.1

BATES LOAM.

The soil of the Bates loam is a brown or gray loam of fine texture, 10 to 15 inches deep, containing only a moderate amount of humus. The subsoil is a dull-yellow loamy clay mottled with dull-red or brown. Fragments of sandstone are sometimes scattered through the soil and subsoil, but the quantity is never sufficient to prevent cultivation. The partially weathered sandstone is usually found at depths of from 2 to 6 feet. The Bates loam is often spoken of locally as "sandy soil" and it is in many places sandier than the classification as loam would indicate. But in the main there is not enough sand in the surface soil to make it a true sandy loam.

This soil is found in large areas in the western part of the county in connection with the Bates clay loam, and there is also a large area in the eastern part of the county. In the latter location much of the soil is a little coarser and more sandy in texture than that found elsewhere, and the subsoil is a yellow sandy clay. Here are also found some glades, or level, undrained spots, in which the soil is finer and of an ashy color, owing to the admixture of silt. In these glades the subsoil is more tenacious than that in the typical sample. The type is derived largely from the sandstone strata of the Cherokee formation, but the shale has entered somewhat into the formation of the subsoil.

The topography is rolling and the type is usually timbered. The native growth is black-jack, black, red, and post oak. Occasionally this soil is found on nearly level divides, in which case it is usually prairie. It is more often found on the breaks of the divides and below the Bates clay loam or on a rounded divide, where it occupies the whole surface. Occasionally it occurs as colluvial material at the foot of slopes. The better phases of the Bates loam have nearly the commercial value and productiveness of the Bates clay loam, and it is suited to the same crops. But the soil is variable in texture and productiveness, owing to the steepness of the topography and the distance of the stone from the surface. Some of it has little more value than the Boone fine sandy loam.

About half of the Bates loam is under cultivation. All the staple crops of the county are grown, the only special crops being watermelons and muskmelons in the vicinity of Jerico Springs. This industry is not as yet very extensive owing to the distance from the railroad, but the home demand is supplied and some melons are shipped. Both melons and truck do well. Corn yields from 10 to 35 bushels per acre, averaging less than 20 bushels. Wheat averages about 10 bushels. Timothy, clover, and bluegrass all do poorly, but cowpeas do well. Fruit does only fairly well. The soil lacks humus, and every effort should be made to increase its organic content by the addition of stable manure and the growing of legumes, cowpeas

seeming to be best suited to the soil. Green manuring would be very advantageous.

The soil is valued at $10 to $30 an acre and occasionally a little higher.

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

Mechanical analyses of Bates 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.*
21406, 21932.....	Soil.....	0.3	1.2	1.1	17.5	24.8	38.6	16.3
21407, 21933.....	Subsoil.....	.2	.7	.6	12.8	18 2	30.2	37.2

BOONE FINE SANDY LOAM.

The soil of the Boone fine sandy loam is a gray fine sand from 10 to 12 inches deep. The first 2 inches are slightly darker on account of the organic matter present. The soil is usually compact and hard. The subsoil is a loamy clay, yellow in color, or yellow mottled with dull red. Sandstone occurs at about 2 feet and occasionally shows on the surface.

This soil occupies the rougher parts of the county. Large areas are found in the central, eastern, and northeastern parts. In the northeastern part the sand is coarser, deeper, and more yellow, and frequently a yellow sandy clay is found resting on the bed rock. Where there is not enough stone to hinder cultivation the land is mostly cleared and farmed, producing better yields than in other parts of the county.

The topography is rolling to nearly level. Drainage is good. The type is derived from sandstone of the Cherokee formation, very little of the shale entering into it. It was originally covered with timber, black-jack oak predominating. It is a poor, thin soil, and except in the northeast part of the county, it is almost entirely uncultivated. The soil is easy to cultivate and with proper management could be made to yield fair returns of melons or other truck crops. The value of this land is very low, ranging from $5 to $10 an acre.

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

Mechanical analyses of Boone 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.*
21404, 21930.....	Soil.....	0.1	0.8	2.7	40.6	15.3	31.7	8.8
21405, 21931.....	Subsoil.....	.2	.5	2.2	31.0	12.8	18.8	34.4

BOONE STONY LOAM.

The soil of the Boone stony loam varies considerably in texture from a brown loam to a light-brown sandy loam and even in a few places to a gray sand. It is from 6 to 15 inches deep and contains from 25 to 50 per cent of broken fragments of brown sandstone. In some areas these fragments are small, from 3 to 10 inches in diameter; in others the stones vary from a foot to several feet in diameter. The subsoil is a yellow loamy clay usually with some dull-red mottlings. It contains a high percentage of stone, from 50 to 70 per cent not being unusual. The unbroken rock generally occurs at depths of 2 to 4 feet.

The Boone stony loam has the same origin as the Boone fine sandy loam with which it is associated, being found in small areas where the topography is rolling to steep, along narrow valleys on the breaks of the hills and on the narrow divides between the streams. It is the result of excessive erosion, the finer particles having been carried away nearly as fast as they were produced by weathering. This soil differs from the Bates clay loam and Bates loam in the greater amount of the stone present and from the Rough stony land in being capable of cultivation. It is noticeable that this soil has very little value, while the corresponding stony loams in the limestone soils are very valuable.

The Boone stony loam is usually timbered, the trees being blackjack, black, and post oak. Occasionally it is prairie. The stone hinders cultivation and most of it is not very productive, even when brought under cultivation. It is best suited to timber and pasture for which it is largely used at present. Its presence among other soils always lowers the value of a farm. It is worth from $5 to $10 an acre.

OSWEGO SILT LOAM.

The soil of the Oswego silt loam is a gray silt loam from 12 to 20 inches deep. In sloughs the surface 4 to 6 inches is brown on account of the higher content of organic matter. The subsoil always consists of two sections, an upper stratum of brown tenacious joint clay and a lower one of a less tenacious clay, which is yellow with a few dull red mottlings. The thickness of the brown material varies from 8 to 24 inches. The lower subsoil extends to an indefinite depth. "Buckshot," or black iron concretions, are often found on the surface. Concretions the size of a pea are also found in the subsoil. These are yellowish to reddish in color and of irregular shapes. A chert, belonging to the underlying Burlington formation, is found outcropping occasionally on the breaks, and in some areas there is considerable fragmentary rock scattered upon the surface. Such areas are indi-

cated in the map by gravel symbol. The subsoil in these stony areas does not show the upper brown stratum found in the typical soil.

On the tops of flat divides where the drainage is poor there is a phase which is locally known as " white-ash " soil. In these spots the soil has a light ash color and the tenacious subsoil is nearer the surface. It is a rather difficult soil to cultivate, as the moisture conditions must be just right.

The Oswego silt loam occurs in two large areas in the southern part of the county and also in several small scattering areas not far from these. It is found in a flat, shallow valley southeast of Jerico Springs and on the crest of a wide flat divide near Rowland. The small areas are located on the tops of the smaller divides. The topography is level, or nearly so. Drainage is apt to be poor, especially in the " white-ash " spots. This is due not only to the topography, but to the impervious nature of the subsoil, which hinders the movement of the ground water.

The Oswego silt loam is derived from a fine argillaceous shale which was evidently laid down only in the southern part of the county, as no evidences of it are found in the northern part. Because of the rapidity with which the shale weathers and erodes, the soil is found only over the more level areas. It is distinctly a prairie type and practically all of it is farmed. What few trees are found are black-jack and post oak. This is a stronger and more fertile soil than the Bates clay loam and Bates loam. Although clover does better on it, and bluegrass is occasionally found, these crops do better on the limestone soils of the county. The wild prairie grasses are especially well suited to the soil and do better than timothy and clover. Redtop is the only tame grass that seems adapted to it. Corn and wheat are the crops mainly grown. Corn yields from 10 to 35 bushels, averaging a little better than 20 bushels per acre. Wheat is better suited to it and yields from 10 to 20 bushels, with an average of 16 bushels. Fruit and truck are also grown on this soil, but the yields are moderate.

Tile drainage would undoubtedly be beneficial to most of this type. Since lime-loving plants are observed to grow on this soil, it seems probable that it does not need as much lime as some other of the soils derived from shales. It will be profitable to save and apply all stable manure and to turn under green crops occasionally to increase the humus content, especially of the lighter ashier phase. This soil is very highly prized by the owners, and many prosperous farms are found on it. It will bring an average price of $25 an acre.

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

Mechanical analyses of Oswego 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.*
21410, 21936...	Soil.....	0.6	2.4	1.9	9.0	5.9	65.7	14.1
21411, 21937...	Subsoil.....	.4	1.1	.6	4.0	3.5	40.5	49.7
21938.....	Lower subsoil...	.7	.9	.9	5.9	12.8	44.4	34.2

WAGONER STONY SILT LOAM.

The soil of the Wagoner stony silt loam is a gray to light-brown silt loam, 12 to 15 inches deep, underlain by a granular yellow or gray friable loamy clay more or less mottled with red. There are from 25 to 60 per cent of angular chert fragments in both soil and subsoil, the large part of which is often concentrated in a zone a foot or so thick and about a foot below the surface.

This type occurs in the central and southern parts of the county. It was originally timbered, the growth consisting mainly of black oak with some post oak and hickory, but has been largely cleared. The topography is rolling and the drainage is good, owing to the surface slope and the permeable nature of the subsoil. Except for the large proportion of stone present, it is an easy soil to cultivate.

A variant of this type occupies a relatively small area. The soil is generally brown, but occasionally gray. Limestone outcrops are often encountered. The areas occupy the steeper portions of the type, lying near streams. Here erosion has been more active and the proportion of rock is higher. On account of its topography and the amount of rock present it is difficult to cultivate, but is more fertile than the typical soil, probably because of the proximity of the limestone. The characteristic growth is walnut, black oak, and grapevines.

The Wagoner stony silt loam is a residual soil derived from the Burlington limestone.

The Wagoner stony silt loam is especially well adapted to grasses and clovers. Bluegrass where introduced has done well. Red clover when grown alone yields 2 tons per acre and often more. Wheat does better than on any of the soils of the Bates, Boone, or Oswego series, and will average about 18 bushels per acre. Corn yields from 20 to 50 bushels per acre and will average 35 bushels.

This soil is adapted to fruit. Apples do very well, but no commercial orchards are found, owing to lack of a ready market. The ordinary price for land of this type is about $35 an acre.

The agricultural practice has depended too much on the one-crop system. This should be changed to a systematic rotation. If clover is included in the rotation, and especially if the cropped fields are rotated with the pastures, as many of the better farmers are doing, and all available manure saved and applied to the soil, the productiveness of the soil should not only be maintained but increased. Erosion should also be guarded against, but this is not as serious a menace as might be expected from the topography, owing to the loamy texture of the subsoil and the quantity of rock fragments mixed through the soil.

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

Mechanical analyses of Wagoner stony 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.*
21944	Soil	1.4	5.2	2.6	6.9	3.6	62.3	17.9
21945	Subsoil	1.0	2.7	2.5	6.8	13.4	42.6	31.0

ELDORADO STONY LOAM.

The soil of the Eldorado stony loam is typically a dark-brown loam, 12 to 15 inches deep, underlain by a loamy clay which is yellow or gray in color with red mottlings, the red increasing with depth. There are from 10 to 20 per cent of angular chert fragments in the soil and from 20 to 40 per cent in the subsoil. The chert is usually white and shows less weathering than the chert found in the other limestone soils of the county. It is an easy soil to cultivate, except for the hindrance of the stone.

The Eldorado stony loam differs from the Decatur stony silt loam, a soil of similar origin, mainly in its dark-brown color, in having a lower silt content, and in containing less stone. It differs from the Wagoner stony silt loam, also of similar origin, in its lower content of stone, darker color, and lower silt content.

These three types are all good wheat, corn, and grass soils, though they differ somewhat in their crop adaptability. The Decatur stony silt loam is the best wheat soil and the Eldorado stony loam is the best grass soil. Both the Eldorado stony loam and the Wagoner stony silt loam excel the Decatur stony silt loam for corn. These three soils are the principal limestone soils of the county.

A large area of the Eldorado stony loam, locally known as the "flint prairies," occurs in the northern part of the county east of Eldorado Springs. Other smaller areas occur in connection with

the Wagoner stony silt loam in the central part of the county. The topography is gently rolling to rolling and the drainage is good. This soil is derived from the Burlington limestone by weathering. It was originally prairie and constituted a part of the range of the early settlers. Most of the native grasses have persisted in the large pastures which have never been plowed. These pastures will carry a steer to 3 acres but must not be pastured too closely. Enough grass is saved in the fall so that it can be burnt off every spring. When treated in this way weeds and sage grass will not enter. Tame grasses on this soil will carry a steer to 2 acres and can be pastured closer than the wild grasses. Practically all of this type is farmed.

As stated the Eldorado stony loam is especially suited to grass both for pasture and hay. Clover does well, either alone or mixed with timothy. Corn yields from 20 to 60 bushels per acre and under good management will average 40 bushels. Wheat averages 17 bushels. Sorghum produces large yields of forage. The statements in regard to agricultural practices and suggestions for improvement given in connection with the description of the Wagoner stony silt loam also apply to this soil. The Eldorado stony loam sells for $30 to $45 an acre.

Eldorado stony loam, gray phase.—In the southern and southeastern parts of the county a phase of the Eldorado stony loam is found in which the surface material is a gray silt loam carrying a somewhat higher content of stone than the typical soil.

It differs from the type in the size as well as in the color of the chert fragments. In the typical soil the chert fragments are rarely large enough to interfere with cultivation. They seldom occur in fragments more than 5 or 6 inches in diameter. In this phase the fragments are found of all sizes from gravel up to 2 feet in diameter. The latter size does not occur abundantly, but 12-inch fragments are abundant. Most of the chert fragments, both large and small, are reddish in color and usually somewhat porous in a zone of half an inch, more or less, in thickness, or depth from the surface, the porosity being due to the leaching of lime that constituted a part of the original rock, while the reddish color is due to oxidation of the iron which accompanied the leaching. The white chert of the typical soil seems to have remained white on account of the lack of any important lime constituent.

As in case of the type, this phase occurs in the prairie. It usually differs from the former, however, in being varied by occasional isolated groups of sassafras and persimmon trees and an occasional black-jack oak. It remained open prairie practically up to a few years ago. At the present time much of it is uncultivated.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Eldorado stony loam:

Mechanical analyses of Eldorado stony 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.*
21950	Soil	0.7	2.6	2.1	10.2	10.6	48.6	25.0
21951	Subsoil	2.3	3.4	2.6	9.1	7.3	41.3	34.0

DECATUR STONY SILT LOAM.

The soil of the Decatur stony silt loam is a dull-red loam from 8 to 12 inches deep. The subsoil is a red loamy clay. The soil contains from 10 to 30 per cent and the subsoil from 20 to 50 per cent of angular chert fragments.

The soil is friable and easy to cultivate, except for the hindrance of the stone. It is found in the southeastern part of the county in the neighborhood of Stockton. The topography is rolling and the drainage good, but erosion is not excessive. The type is residual and derived from the Burlington limestone, and the chert found in it is also from the same source.

This soil was originally partly prairie and partly timbered. The forest growth was walnut, hickory, and oak. It is now nearly all cleared and farmed and is one of the very best soils in the county. It is especially suited to wheat. Grasses, all the staple crops, and fruits do well. Corn yields from 20 to 60 bushels per acre and will average about 35 bushels. Wheat yields from 10 to 25 bushels per acre, averaging 20 bushels or more under good management. The soil is valued at $35 to $45 an acre.

The following table gives the results of mechanical analyses of the soil and subsoil of the Decatur stony silt loam:

Mechanical analyses of Decatur stony 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.*
21946	Soil	0.9	2.0	4.7	6.1	5.1	59.2	21.9
21947	Subsoil	1.4	3.0	3.9	4.4	6.7	37.6	43.0

DECATUR SILT LOAM.

The soil of the Decatur silt loam is a dull-red or brown silt loam 12 to 20 inches deep. The subsoil is a red clay loam, without mottling,

or occasionally a dull red mottled with gray. There is usually very few rock fragments in the soil, but sometimes they appear in quantities ranging up to 20 per cent. The fragments consist of a weathered chert.

This type is of limited occurrence in the county and is found on nearly level or gently rolling situations on the uplands, where it forms prairie, and as bench land along Cedar Creek and Sac River, where it was originally wooded, but is now cleared. The original timber growth consisted of walnut, hickory, and the larger species of oak. It is a residual soil derived from the Burlington limestone, both in the upland and on the benches.

The Decatur silt loam is a very fertile soil and has been farmed since the settlement of the county. It is well suited to pasture, hay, and all the staple crops of the county and is especially desirable for wheat. Corn will average 40 bushels per acre and wheat 20 bushels or more. Oats, timothy, clover, and alfalfa all do well. This soil is valued at $40 to $50 an acre, but very little of it is on the market.

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

Mechanical analyses of Decatur 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.*
21948	Soil	0.2	1.2	1.1	6.4	5.3	67.5	18.2
21949	Subsoil	.2	1.2	1.3	6.3	11.6	39.9	39.2

GUTHRIE SILT LOAM.

The soil of the Guthrie silt loam is a dark-gray to dark-brown silt loam, 12 to 20 inches deep, shading into a light gray in the lower depths. The subsoil is a gray to drab silty clay with yellow mottlings. A small quantity of chert gravel is found in both soil and subsoil.

This is an unimportant soil and occupies only a few small areas in the county. It is found in flat, undrained spots surrounded by other limestone soils. It differs from the surrounding stony loam in the almost entire absence of stone, the more impervious nature of the subsoil, and the somewhat lighter color of the surface soil. These spots have apparently been formed in flat areas or possibly in depressions where erosion has been absent, and they have received more or less wash from the surrounding land. The Guthrie silt loam was originally prairie. It is locally known as "crawfish land," and under natural conditions is too wet for growing crops. Tile drainage would

undoubtedly be beneficial if it did not entirely remove the difficulties now encountered in cultivation.

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

Mechanical analyses of Guthrie 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.*
21952	Soil	0.4	2.6	1.3	9.5	4.8	60.7	20.5
21953	Subsoil	.4	.9	1.0	9.0	6.3	39.7	42.9

CLARKSVILLE STONY LOAM.

The soil of the Clarksville stony loam is a light-gray silt loam, 12 to 18 inches deep. The subsoil is a yellow loamy clay with a few mottlings of red. Both soil and subsoil contain from 50 to 75 per cent of angular chert fragments. In places this type occurs as low ridges rising above the surrounding Wagoner stony silt loam. These ridges are essentially the same in origin, but mark the resting place of unusually large accumulations of chert. In other localities this soil is found on narrow divides where erosion has been very severe, and here the condition is evidently the result of the finer soil particles being washed away.

Clarksville stony loam, flat phase.—The soil of the Clarksville stony loam, flat phase, is a gray or yellow silt loam, 8 to 12 inches deep. The surface soil carries about 25 per cent of angular chert fragments, most of them from 3 to 12 inches in diameter. Immediately below this is a dense layer of chert, extending to a depth of at least 3 feet. To a depth of 20 inches interstices between the fragments are filled with a yellow silty clay having slight mottlings of red. Below this the fine material becomes gray, with red mottlings, or in some cases red. The lower depths consist of a tenacious silty clay. The origin of this phase is not certain, but it seems probable that it has been formed by a mixture of the limestone materials with materials from the Cherokee shale formation.

This phase is found in small areas south of Stockton. The topography is level to gently rolling and this, with the retentive subsoil, causes it to hold water very tenaciously. As a consequence "hog wallows" are formed in the roads.

The native forest growth on both the typical and flat phase areas is scrub post oak with a few black-jack oaks. Some of the flat phase was originally prairie and an attempt was made to farm it, but it was soon abandoned. The type as a whole is now covered with a

growth of scrubby post oak. It is a refractory soil to handle, owing to the large content of stone and poor drainage. Neither is it a productive soil when these difficulties are overcome. Its greatest usefulness is probably for grass land. It is worth from $5 to $10 an acre.

The following table gives the results of mechanical analyses of fine-earth samples of the soil, subsoil, and lower subsoil of the flat phase of the type:

Mechanical analyses of Clarksville stony 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.*
21940	Soil	0.3	1.6	1.3	3.6	4.8	70.9	17.5
21941	Subsoil	8.5	4.6	1.9	5.0	11.7	47.5	20.8
21942	Lower subsoil	11.5	5.1	1.5	4.3	13.2	40.1	24.1

HANNIBAL SILT LOAM.

The soil of the Hannibal silt loam is a heavy dark-brown silt loam, 8 to 10 inches in depth. The subsoil is a bright-yellow or often a greenish-yellow silty clay which in the lower depths shades into tenacious grayish-yellow clay. The soil varies a good deal in its content of stone. Where found in narrow valleys it carries from 10 to 40 per cent of broken fragments of Hannibal sandstone, these occurring mostly in the surface soil. In the wider valleys very little stone is found except a narrow rim on the breaks of the hills. The soil has a friable structure, and when well drained and there is not too much stone present it is easy to cultivate. When undrained and wet it becomes quite sticky and is difficult to handle.

The Hannibal silt loam is found in the eastern part of the county on the smaller streams tributary to the Sac River and as narrow strips at the base of bluffs on a few of the larger streams in the same neighborhood. It occurs as gentle slopes just above the bottoms of the streams where found or as small shallow valleys leading down to these streams. The location and topography are due to its origin from the shale of the Hannibal formation. The formation in this county outcrops only near the bottom of the stream channels in the eastern part. The shale is very easily weathered and is rarely found in its unaltered condition. The sandstone, which overlies it, is not a thick stratum and weathers very much slower than the shale. Therefore, it is found on the hillsides and narrow valleys in broken pieces mixed with the soil resulting from the shale. Where this soil is low lying the drainage is poor, but otherwise it is very fair. Many of the fields would be benefited by tile drainage.

This is not an extensive soil and of no great agricultural importance, although most of it is cleared and is fairly productive. It is said to be an especially good wheat soil, and corn will yield fair crops. As it occurs in such small areas, it is never sold separately, but is worth from $20 to $30 an acre.

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

Mechanical analyses of Hannibal 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.*
21954	Soil	0.4	1.2	1.6	5.3	10.5	60.9	20.2
21955	Subsoil	1.0	1.9	1.6	4.5	10.4	57.8	22.7

OSAGE FINE SANDY LOAM.

The soil of the Osage fine sandy loam is a dark-brown or grayish-brown fine sandy loam, containing considerable humus. The subsoil is a brown or dull-yellow loam or fine sandy loam, containing less humus than the surface soil. This soil varies considerably in texture and often within short distances, the surface in places approaching a loam and in others a sand. The subsoil is never a clay and is usually only a little heavier than the surface soil. In some instances it is a sand.

This type is recently formed alluvium, and is found on the bottoms of the smaller streams of the county where they drain areas derived from sandstone and shale formations. Most of this type was originally covered with a growth of timber consisting of walnut, ash, maple, oak, pawpaw, etc., and the popular name for the type is "walnut and pawpaw bottoms." The soil has good natural drainage and is quite fertile. Owing to its location on the smaller streams danger from overflow is slight. It is highly prized, but as it occurs in small areas it is always sold with the adjoining soils. The Osage fine sandy loam was among the first soils cleared and farmed by the early settlers. The timber is now practically all removed, with the exception of a few trees directly on the banks of the streams.

The yields of corn and all staple crops are excellent, being very nearly, if not quite, equal to those of the Osage silty clay loam. Potatoes do quite well; in fact, this is the best potato soil in the county. The suggestions for management found under the Osage silty clay loam will apply equally well to this soil.

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

Mechanical analyses of Osage 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.*
21416, 21958.....	Soil.....	0.2	0.2	1.1	35.9	17.7	30.7	13.9
21417, 21959.....	Subsoil.....	.1	.5	2.4	46.7	14.9	23.4	11.8

OSAGE SILTY CLAY LOAM.

The soil of the Osage silty clay loam is a brown to black friable silty clay loam from 8 to 24 inches deep. The subsoil is very similar to the surface soil, though slightly heavier. It also is a little lighter in color, owing to a smaller content of organic matter. Some variations in color and texture occur. The surface may be a dark gray or a dark brown. The texture is also variable, as is likely to be the case in alluvial soils, but the type is a tenacious, difficultly handled soil only in small areas of a heavy phase. The texture of the subsoil is always very nearly the same as that of the surface soil.

The Osage silty clay loam is of recent alluvial origin, and is derived from reworked material from the adjacent uplands, being apparently a mixture from the sandstone, shale, and limestone soils. It is found on all the large streams of the county and along a few of the smaller streams draining limestone areas. The type has a level to sloping surface and is sometimes poorly drained.

Originally the areas of this soil were covered with a heavy growth of walnut, hickory, elm, and pawpaw, and hence its name "walnut bottoms." This was one of the first soils cleared and farmed by the early settlers, and at the present time it is nearly all cleared. It is subject to overflow, but usually the water recedes within twenty-four hours; therefore if the overflow comes late and covers the corn crop it does no serious damage. The permeable nature of the soil allows the water to drain away quickly, so that it does not become waterlogged on account of these overflows. However, about once in fifteen or twenty years, there occur late overflows of sufficient duration practically to destroy the crops. Fields on this soil are very apt to be filled with cockleburs and other noxious weeds. The seeds from the fields of the careless farmer are distributed by the water over the fields of all the farmers below him. This makes it very hard to keep any of the fields free from weeds.

The Osage silty clay loam is the best corn soil in the county. Under good management it will produce from 40 to 80 bushels per acre,

though under the present treatment the average is probably about 40 bushels. Sorghum sown for feed during the first half of July makes a splendid growth before frost, producing a large amount of forage. This gives the farmer a chance to grow some forage, even in years of late overflow. This soil is also suited to oats, wheat, timothy, and, when well drained, to alfalfa, but comparatively small acreages of these crops have been grown. It has been the custom of most of the farmers to grow corn year after year. Rich as this soil is, it would be better to practice rotation. Wheat could be put in after corn and clover sown with the wheat. This would give wheat the first year and clover the second, which could be followed by corn for two or three years, depending upon the condition of the soil.

The Osage silty clay loam is worth from $40 to $50 an acre.

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

Mechanical analyses of Osage silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21418, 21956, 21962.	Soil.....	0.0	0.6	0.4	1.9	4.8	70.3	21.7
21419, 21957, 21963.	Subsoil.....	.1	.7	.5	2.0	5.2	69.0	22.4

OSAGE SILT LOAM.

The soil of the Osage silt loam is a gray silt loam 6 to 15 inches deep. The subsoil is a fine silt or silty clay carrying at some depth a stratum that is quite impervious to water. There are two phases of the subsoil, either or both of which may appear within a given area. The first phase is a light-gray or ash-colored silt that may extend to a depth of 3 feet or more. It is frequently loose and offers no great resistance to the passage of water, but it is often compressed into an impervious hardpan that practically stops the flow of water. This hardpan apparently owes its structure to mechanical forces and not to the presence of any cementing material. Just what brings about this compacted condition is not certain. The areas of the hardpan are very erratic in distribution. They may occur within 6 inches of the surface or 30 inches or more below or one stratum may lie below another, and then a few rods away the hardpan may entirely disappear. The second phase of the subsoil is a dark-brown tenacious clay or silt clay found 15 to 36 inches below the surface. It generally occurs below the stratum of the gray silt phase. It is quite impervious, but generally lies lower than the gray silt hardpan.

The Osage silt loam is found in large areas on the flood plains of the large streams of the county, and in small areas on some of the smaller streams. It is an alluvial soil and has apparently been derived from reworked material from silty shale beds occurring on the adjacent uplands. On the smaller streams it generally occurs as second bottom. Here it is cultivated, being found fairly easy to drain and manage, and, when not too wet, easy to cultivate. On Bear Creek and the East Fork of Sac River it occurs mostly at sufficient elevation above the streams to allow drainage, and in such places, too, the subsoil is fairly pervious to water. Here it is mostly cultivated and moderately productive. On Sac River it generally occurs as low bottoms difficult to drain and largely uncleared. Drainage is one of the principal problems of this soil, owing to its frequent low-lying situations and its often impervious subsoil. On the large streams it is subject to overflow and after the surface water has drained off it takes the soil a long time to dry out, differing markedly in this respect from the Osage silty clay loam which occurs in the same bottoms.

Originally the Osage silt loam was mostly covered with various water-loving trees, the water oak (*Quercus palustris*) predominating, and it is popularly known as "water-oak bottoms." Some of the type was originally treeless and was known as "prairie bottoms." This soil varies considerably in agricultural value, depending upon the depth of the impervious stratum in the subsoil and the ease with which the land can be drained. The better phases have been cleared, but as ordinarily handled they lack the productiveness of the Osage silty clay loam. Many farmers have attempted to grow corn continually on this soil, but the yields soon decrease. It is better suited to wheat than corn; in fact, it is an especially good wheat soil. The following rotation has been found very satisfactory by one who has been very successful in handling a large body of the Osage silt loam: Corn one year, wheat one year, and clover and timothy two years. He has found the soil very productive under this management.

Drainage of course is the first thing to be looked after in improving this type. Some of it is being tiled and this will undoubtedly pay. It is probable that with thorough drainage and proper cultural methods the patches of hardpan will largely disappear. This is suggested because the better drained areas have very little hardpan. The next step is proper rotation and the plowing under of green manure. The soil lacks organic matter and responds very readily to the growing of clover and the application of barnyard manure. Areas that are too low to be profitably drained could be reforested. Probably the sycamore would be as profitable as any tree. It is perfectly at home on this soil and in twenty-five years a good market-

able tree can be grown. When properly managed this soil will average 30 bushels of corn to the acre and wheat will make at least 20 bushels. The better phases of this soil sell for $25 to $30 an acre, the wetter areas bring from $10 to $20 an acre.

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

Mechanical analyses of Osage silt loam.

Number.	Description.	Fine gravel.	Coarse sand	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21420, 21960.....	Soil.....	0.8	1.7	0.8	7.9	9.1	64.5	15.2
21421, 21961.....	Subsoil.....	.5	1.1	.8	8.8	8.9	41.9	37.9

ROUGH STONY LAND.

Rough stony land is a term applied to extremely stony or steep rough land entirely unfit for cultivation and valued only for its timber growth and for the small amount of pasture it may afford. Small areas are found in all parts of the county, but mainly along the large streams, where, on account of the steep topography, erosion has overtaken weathering. The areas of Rough stony land represent all the geological formations found in the county, and occur as bluffs, steep stony slopes, rock exposures, and large accumulations of chert.

SUMMARY.

Cedar County lies in the southwestern part of Missouri, on the borders of the Ozark region. The surface is rolling and in a few places rough, and the drainage is carried by the Sac River into the Missouri River.

The first settlers came from Tennessee in 1830 and the county was organized in 1845. Agriculture has been the sole industry from the first.

The northwestern part of the county is served by a branch of the Missouri, Kansas and Texas Railway that runs to Eldorado Springs. The rest of the county is without adequate railroad facilities.

The climate is well suited to the growing of corn, small grain, and grass, and to the raising of stock. The rainfall is ample and the winters are not severe.

The early settlers found one-half of the county covered with timber, and there is still a great deal in the county. Stock raising has been the main industry from the very start, and to-day it predominates. Wheat is the only grain sent out of the county. Around

Eldorado Springs fruit and truck are raised in a limited way for shipment.

Cedar County lies on the border line between the soil provinces—the residual soils of the western prairies and the limestone soils of the Ozark region.

The western prairie soils are represented by the Bates, Boone, and Oswego series, locally known as "sandstone soils." Taken as a whole they are the least fertile soils of the county, although they are nearly free from stone and easy to cultivate.

The Ozark soils are formed almost entirely from the Burlington limestone, which has produced the soils of the Clarksville, Decatur, Eldorado, Wagoner, and Guthrie series. These are strong fertile soils, but most of them contain a large percentage of chert, which materially hinders cultivation. A very little soil has been produced by some lower formations which outcrop near the watercourses of the larger streams.

Alluvial soils are found on all the large streams, the bottoms in places being a mile wide. These are very fertile, but are subject to overflow, and some of them lack drainage.

The soils of the Bates and the Boone series are lacking in organic matter, but respond promptly to applications of barnyard manure. Cowpeas do very well on these soils and should be used in all rotations. Red clover is suited to the limestone soils and should be more largely grown. On all the soils the farmers should pay more attention to systematic rotation, clean culture, and the saving and application of all barnyard manure.

The county seems especially suited to dairying, not only in climate, soils, and crops, but because of the existence of good herds of cattle that would make fine foundation stock for dairy herds.

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