

Issued October 14, 1912.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS—MILTON WHITNEY, Chief.
IN COOPERATION WITH THE UNIVERSITY OF MISSOURI, AGRICULTURAL
EXPERIMENT STATION, F. B. MUMFORD, DIRECTOR.

SOIL SURVEY OF LACLEDE COUNTY, MISSOURI.

BY

DAVID D. LONG, OF THE U. S. DEPARTMENT OF AGRICULTURE,
AND E. C. HALL AND H. KRUSEKOPF, OF THE
UNIVERSITY OF MISSOURI.

HUGH H. BENNETT, INSPECTOR IN CHARGE SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1911.]



WASHINGTON:
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1912.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., March 11, 1912.

SIR: In the extension of soil-survey work in the State of Missouri work was undertaken in Laclede County during the field season of 1911. This work was done in cooperation with the University of Missouri Agricultural Experiment Station, F. B. Mumford, director, and the selection of the area was made after conference with State officials.

I have the honor to transmit herewith the manuscript report and map covering this area and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1911, as provided by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

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MAP.

Soil map, Laclede County sheet, Missouri.

SOIL SURVEY OF LACLEDE COUNTY, MISSOURI.

By DAVID D. LONG, of the United States Department of Agriculture, and
E. C. HALL and H. KRUSEKOPF, of the University of Missouri.

DESCRIPTION OF THE AREA.

Laclede County is located in the south-central part of the State of Missouri, in the region known as the Ozark Plateau. It is bounded on the north by Camden County, on the east by Pulaski and Texas Counties, on the south by Wright and Webster Counties, and on the

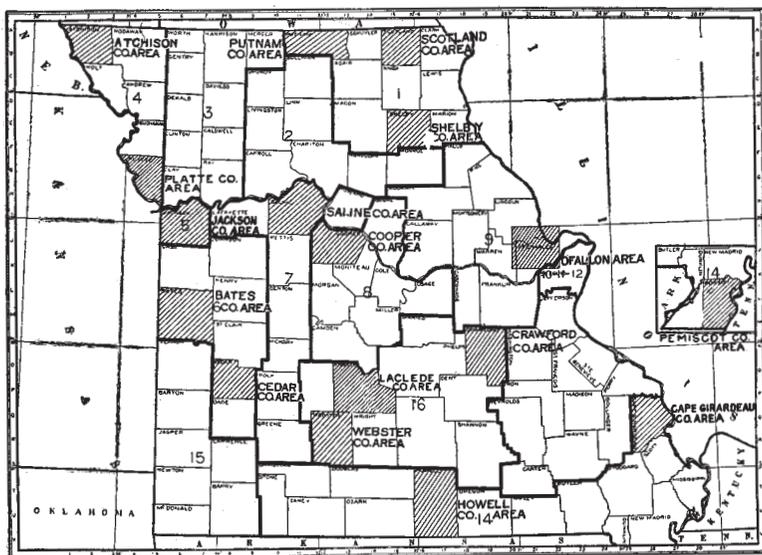


FIG. 1.—Sketch map showing areas surveyed in Missouri.

west by Dallas County. The area contains 735 square miles, or 470,400 acres. The county was formed in 1849 by lands segregated from Pulaski, Wright, and Camden Counties.

The county being situated upon the summit of the Ozark Plateau, presents a varied topography, consisting of valleys, table-lands, prairies, and hilly regions. Broadly speaking, the region embraces two main topographic divisions, viz, a high upland plain division and a low plain country near the larger streams.

The upland plain lies at an altitude ranging from 1,000 to 1,400 feet above sea level. The elevations of various stations on the St. Louis & San Francisco Railroad, which traverses this plain, are as

follows: Stoutland, 1,170 feet; Sleeper, 1,218 feet; Lebanon, 1,266 feet; Phillipsburg, 1,413 feet, and Conway, 1,404 feet. It will be noted that the altitude increases from north to south.

The Upland Plain occupies the divides or interstream areas of the county, the most important of which is found between the Niangua River and the Osage Fork of the Gasconade River, comprising the level lands in the vicinity of Lebanon, Phillipsburg, and Conway, in addition to the eroded stream belts. Smaller extensions occur in the vicinity of Morgan, where it forms the watershed between Brush and Panther Creeks, and Brush Creek and the Osage Fork. This plain is also developed between the Osage Fork and the Gasconade River and between the latter stream and Roubidoux Creek, which is located in Texas and Pulaski Counties. The eastern county line is located somewhat east of the top of the latter divide.

The upland-plain country is level to undulating. Erosion has dissected much of the original level country, giving rise to the associated rolling areas. In the eastern part of the county, except for level areas in the neighborhood of Lynchburg, it is badly eroded. The streams or tributaries of the rivers running nearly at right angles to these main watercourses have cut the county into long, narrow ridges, which have been still further dissected by smaller drainage ways forming subsidiary ridges. Erosion has been active in the vicinity of all the streams which are cutting back into the upland plain. In the northwestern part of the county the streams have not as completely dissected the region, but have cut deep and narrow valleys. The hills, which rise as high as 100 to 200 feet above the bottom of the valleys or ravines, are generally level to flat topped and may be from one-fourth to one-half mile in width, while in the eastern part of the county they are in many places just wide enough for a road. Surrounding the level areas is a stretch of hilly land which is found at the edge of the plain as it drops to the low plain country.

The second division comprises the low plain country along the Gasconade River and Osage Fork. This topographic division is not stream-terrace land. It is simply a zone of lower country through which the highland plain drops off to the alluvial bottoms. These lands are found on both sides of the rivers running through the county, extending back for a distance of 1 to 5 miles. Along some of the main tributaries of the rivers such as Cobb Creek, Stearns Creek, Spring, Dry Auglaize, Bear Creek, and many smaller creeks the low plain extends farther back into the High Plains. Between Orla, on the Osage Fork, and Competition, on the Gasconade River, the low plains along the two streams join. In the vicinity of the Niangua this division is narrowest. The country is generally rough and badly dissected, with the exception of the southern part

of the county, between Orla and Competition, where many smooth slopes, with small, level interstream areas are found.

The general direction of the drainage of Laclede County is to the north. The drainage waters are carried by the Gasconade, Osage Fork of the Gasconade, and Niangua Rivers and their tributaries. The Gasconade is the largest stream. Pine and Prairie Creeks are the chief tributaries, with the exception of the Osage Fork. The chief feeders of the Osage Fork are Panther, Brush, Stearns, Big Cobb, Little Cobb, Cobb, and Senlon Creeks. These streams drain the south-central and east-central parts of the county. The western part of the county is drained by the tributaries of the Niangua River, Spring Creek, and Mountain Creek. The northern part of the county is drained by the Dry Auglaize and Bear Creeks.

A small proportion of the drainage is carried by surface streams, the water rapidly sinking to underground courses. Even in some of the largest streams the water sinks beneath the surface, leaving the stream bed dry or containing only pools here and there. Many streams carry water only immediately after rains. Such streams are termed intermittent and are shown on the map by broken lines.

The first settlement is said to have been made in 1820 on the east side of the Gasconade. Settlements on the Osage Fork and Bear Creek occurred about four years later, while the county in the vicinity of Lebanon was not settled until 1830-1835. Settlement did not reach the western part of the county until 1843, when a family settled in Spring Hollow. The first settlers were chiefly from North Carolina and Tennessee. The present population of the rural districts is made up largely of descendants of the early settlers, although many others have taken up land since then. The rural districts are sparsely settled, the bulk of the inhabitants being found along the water courses and near the railroads. Although the farms are scattered, the farmers are within easy communication. An extensive system of telephone lines and rural free delivery of mails exist. The population of the county as given by the census of 1910 is 17,363.

The chief town and trading point of the county is Lebanon; also an important educational and residential center. This town is the county seat and has a population of 2,430. It has modern improvements, a well-organized school system, and churches. It is located in the west-central part of the county in a level part of the Upland Plain. Conway and Phillipsburg, situated in the southwestern part of the county, are the next towns of importance. The smaller towns away from the railroads consist of one or two stores and a few houses.

The St. Louis & San Francisco Railroad offers the only transportation facilities of the area, traversing the county from the northeast to the southwest and having a monopoly on all the shipments to and from the county. The people in the eastern part of the county haul

their freight by wagon from Lebanon. The longest haul from the railroad is from Lebanon to Lynchburg, a distance of 35 miles. The wagon roads of the county are hilly and range from poor to fair. The majority follow the ridges or hollows.

Cattle and poultry are the chief products shipped to outside markets. These go mainly to St. Louis, Chicago, and Kansas City.

CLIMATE.

The climate of Laclede County is mild and equable. The heat of the summer is not especially oppressive, while the winters consist of alternately mild and cold periods of weather. During the summer the nights are generally cool and afford great relief from the hot days. Foggy days are practically unknown, except along the river bottoms. Zero weather is rare, there being only one or two days a year when the temperature drops to that point. Little ice forms on the ponds, the quantity being insufficient to supply local demands. Snow does not remain on the ground for any length of time.

The average growing season lasts from April 15 to October 15. The latest date for the last killing frost in spring is given as May 9. The earliest and latest dates for the first killing frost in fall were October 9 and November 12. These dates are based on records covering a period of 20 years at the Weather Bureau station in Lebanon.

Climatic conditions have seriously retarded the development of orcharding, as during the past 10 years there have been five crop failures due to the freezing of the buds. Abnormal warm periods in February and March start the buds and subsequent freezes are disastrous. Slight droughts usually occur during July and August.

The following table gives the salient features of the climate. The data are compiled from records kept at Lebanon and cover a period of 20 years.

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

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	<i>° F.</i>	<i>° F.</i>	<i>° F.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
December.....	36.0	76	-15	2.80	4.66	1.15	2.78
January.....	33.0	74	-18	2.48	1.17	1.13	6.9
February.....	33.1	78	-28	2.67	1.85	1.37	5.6
Winter.....	34.0			7.95	7.68	3.65	15.28
March.....	46.2	90	3	3.95	3.95	3.76	2.8
April.....	56.2	89	20	4.70	3.43	5.01	.87
May.....	65.4	99	28	5.88	.64	13.65	
Spring.....	52.7			14.53	8.02	22.42	3.67

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

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.
June.....	72.5	102	45	5.61	1.87	8.56	.....
July.....	76.0	109	54	4.27	1.85	5.73	.....
August.....	75.8	103	47	3.43	1.93	4.07	.....
Summer.....	74.8	.....	.....	13.31	5.65	18.36	.....
September.....	70.0	103	31	3.72	2.35	5.43	.....
October.....	58.5	93	22	2.96	1.38	2.79	.....
November.....	46.0	80	6	2.63	1.90	1.92	.1
Fall.....	58.1	.....	.....	9.31	5.63	10.14	.1
Year.....	55.7	109	-28	45.20	26.98	54.57	19.05

AGRICULTURE.

Stock raising was the first industry to receive attention in Laclede County, the abundance of grass covering the ridges affording the stock ample food supplies during the entire year. The first settlements being made in the river bottoms, a good supply of water was also available. In connection with stock raising, small fields were cleared in the bottoms and corn, wheat, and oats planted. The surplus grain was fed to hogs and cattle. Prior to 1825 the nearest gristmill was on the Meramec River, now Stanton Station, 100 miles from the settlements. St. Louis was the nearest market, and the hauling was done by ox teams. The freighters also made trips to Springfield and to Jefferson City. The principal merchantable commodities of those days consisted of live stock, furs, and honey. Whisky was also a commercial article.

This system of agriculture continued with a steady growth. New settlers continued to take up land until the bottom lands were well occupied. Very few people cultivated the ridges. The Civil War in 1862 checked immigration for a time. Fields were neglected, and by the time the men returned the farms were overgrown with brush and the fences and buildings were in a dilapidated condition. Without financial resources or stock, the cultivation of the fields was a difficult task, but the land was finally brought again under cultivation. The methods of cultivation at this time were crude, as the land was broken by prairie or bar-share plows drawn by oxen; harrowed with a brush harrow, which consists of brush pulled over the ground to smooth the surface; the corn was dropped by hand and covered with

a hoe. In 1869 the agriculture and improvements were greatly stimulated by the building of what is now the St. Louis & San Francisco Railroad, which did much to open up the county.

With the opening of the railroad in the early seventies, the influx of immigration, and consequent decrease in open range, grain farming came into general favor. Soon all the bottom lands were taken up, and newcomers were forced to locate on the ridge lands. With the cessation of the annual fires to burn over the ranges, constituting prairie land with occasional large blackjack trees, these were soon covered over in considerable areas by a growth of scrub oak, and to-day the only available grazing land is found in scant patches between the trees or over the stony and hilly sections of the county.

The crops consisted of corn, wheat, oats, and hay. The census of 1880 showed 22,793 acres in corn, yielding 736,111 bushels; 15,132 acres in wheat, yielding 128,152 bushels; 5,225 acres in oats, yielding 98,800 bushels; and 3,759 acres in grasses for hay, yielding 3,167 tons. Barley and buckwheat were also grown to a slight extent. The last two crops have been abandoned during the last two decades.

Corn continues to be the chief crop. During the interval from 1880 to 1900 the area planted to this crop has increased 6,592 acres. The total yield for 1899 was 837,240 bushels. It is noticeable that the average yield per acre within the last 20 years has declined from 32 bushels to 21 bushels. This decline is not entirely due to the decrease in soil fertility, as it must be remembered that in 1880 most of the corn was grown in the bottoms, while in 1900 the increased acreage was largely represented by upland soils, which are not as productive as the bottom-land soils.

The average yield of wheat increased from 8.4 bushels per acre in 1880 to 9.5 bushels in 1900. The acreage in wheat in 1900 was 15,841 acres. Oats are grown at the present time only to a limited extent, although in 1890 this crop showed 12,406 acres. In 1900 the acreage decreased to 6,525, or almost 50 per cent. The further decrease at the present time is due to low yields and to the larger profits in growing corn.

So far as the physical characteristics of the upland soil of this region are concerned it is adapted to most of the grasses, especially to the bunch grasses. All except the extremely stony land will grow bluegrass. The percentage of the silt and clay particles in these limestone soils is abundantly sufficient to constitute a natural grass soil. All of the silty and moderately gravelly soils are natural clover soils, but in most cases great care must be taken in seeding, and the humus content of the soil must be increased before a good stand can be secured. Red clover is, all things considered, one of the most valuable crops grown in the county. A soil that grows clover successfully may be kept in a high state of productiveness indefinitely.

A soil that will not grow clover or some similar renovating crop will require in a short time the purchase of costly commercial fertilizers. No one thing more clearly indicates the intelligence of the farmers or reflects more creditably upon their system of farming than the area devoted to this crop.

For pasture purposes, in connection with the bluegrass, white clover is one of the most valuable plants in the region. It is perennial and does not require to be seeded. It grows luxuriantly on all classes of soils. Fortunately its maximum growth occurs during the latter part of June and early July, at the time when the bluegrass is usually dormant. It is particularly adapted to the gravelly and flinty soils of the region.

Japan clover is one of the most nutritious of the clovers and has now spread over practically the whole of the Ozark region. It thrives well in the timber as well as in the open land and furnishes valuable grazing through the latter half of the summer and early winter.

Live-stock farming is carried on extensively within the county. The value of all live stock, as given by the census of 1900, was \$737,944. This amount showed an increase of \$335,203, or 82.9 per cent over the value of 1880. According to the census of 1910 the number of live stock in the area was as follows: Cattle, 22,928; horses, 8,787; mules, 2,287; hogs, 27,601; and sheep, 26,616. The value of all these animals was approximately \$2,000,000. The value of all surplus live stock produced annually is about \$750,000. The feeding of live stock is restricted chiefly to the bottom lands along the water courses, where plenty of water, corn, and pasture can be secured. The cattle are generally secured from the farmers on the uplands and fed, although very few are put on the market as finished cattle. Drovers of cattle are often driven or shipped to northern Missouri for finishing purposes. The county does not produce sufficient corn for the feeding of the cattle, as an estimated amount of 30,000 bushels is shipped into the county annually for this purpose. The cattle are of the beef type, consisting of the Shorthorn, Hereford, and Aberdeen-Angus breeds, in the order named. Only a few dairy herds are found in the county, these being chiefly Jerseys. The hogs are chiefly Poland-China, Duroc-Jersey, and Berkshire, and the sheep Shropshires and Oxford-Downs. The stock is improving steadily, as the stockmen are beginning to realize the value of pure-bred animals.

Because of the relatively small area of soils suited to grain production and the large area of pasture land, live-stock raising must of necessity be the basic industry of the farming system. The live-stock industry, however, will not include cattle feeding, except to a limited extent, because of the lack of an abundant supply of grain. The production of cattle as "stockers" and the raising of young horses and

mules to be sold when 1 or 2 years old is practiced at the present time, and probably is the most practical and remunerative system of agriculture for this region. The business of breeding and feeding sheep is rapidly growing in the Ozarks. The climate, soil, and good water render this section particularly well adapted to the production of high-grade sheep.

The present agricultural conditions and practices are undergoing a period of readjustment, and have as yet not assumed that stability which characterizes some of the older sections of the State. The early agriculture was based primarily on stock raising, but with the advent of the railroad and better shipping facilities this was superseded by grain farming. The decreasing fertility of the land and the resultant reduced crops and the larger and easier returns that are to be had from stock raising are again causing the farmers to abandon grain farming, and live-stock raising, together with the growing of grass and corn, is becoming the leading industry. There is every reason to believe, and a slight beginning has already been made, that the future agriculture, especially in the region along the railroad, will be based partly on dairying. The favorable climatic conditions, good pastures, abundance of water, ready shipping facilities, and the necessity of maintaining the fertility of the soil will all combine to bring about this change.

Great strides have been made in the last 10 years in the improvement of farm practices. The use of modern implements is extending to all sections of the county where the topography permits. The turn plow is generally used, drawn by two horses, or occasionally by three. During the last few years sulky plows have been introduced and are now used here and there. The harrows are chiefly disk and spike-tooth. About 10 per cent of the cultivators are of the riding, single-row type. Check-row corn planters are practically the only kind purchased at present. On account of the decreased acreage in wheat, very few drills and harvesters are brought into the county. The corn cutter is superseding the corn harvester. Some subsoil plows are employed, and their use should be more common.

Land in the stream bottoms is generally broken for the crops in the spring, which, on account of the danger of floods in the early part of spring, is the best plan to follow. The upland soils, on the other hand, should be plowed in the fall in order to subject the soil to the fining processes of freezing and thawing, which improves the physical condition. Where fall plowing is done the land should be harrowed as early as possible in the spring, before the upturned soil has a chance to lose its moisture. The depth of plowing should be governed by the depth of the surface soil, and the plows should reach a little way into the subsoil, but not enough to turn much of the subsoil to the surface.

Corn may be planted at any time from April 1 to May 15, but early planting is desirable. Methods vary from dropping the corn by hand and covering it by dragging a stone over the furrow to the use of a check-row planter. The use of the check-row planter is increasing, although a large acreage is still dropped by hand and covered with a hoe. When it is checked the rows are from 3 to 3½ feet apart. The crop is cultivated from two to five times, although many farmers keep the cultivator running as long as they can. During the last season of drought the value of intensive cultivation was clearly demonstrated, as the farmers who continually worked the corn produced from 15 to 25 bushels more per acre than those who followed the older methods. The corn is laid by about the middle of July and harvested about September.

Most of the corn produced is grown on the bottom lands. White varieties predominate, the most important being the Boone County White and Iowa Silver Mine. Of the yellow varieties, the Reed Yellow Dent and Iowa Gold Mine are the most popular.

The acreage of wheat is decreasing on account of the low yields. The chief difficulty seems to be failure to stool and head properly. Often only one or two culms develop and bear short heads, the upper and lower kernels being small and shriveled. Lack of organic matter and unfavorable physical conditions in the soil presumably have much to do with this. Applications of 5 to 10 tons of stable manure to the acre would overcome this tendency toward imperfect development, in part at least, but in many cases the manure is unavailable. The turning under of cowpeas would be a good substitute when sufficient manure can not be secured. Applications of acid phosphate or ground phosphate rock would doubtless improve the yields. These could be added with the manure. As a general rule wheat is only grown as a nurse crop with grass. The crop is seeded in September and harvested in July. The Fultz, Russian Red, Mediterranean, and Fulcaster are the varieties commonly grown.

Oats are either seeded broadcast or with a grain drill upon disked land, the land not generally being plowed for this crop. Seeding takes place about the latter part of March or beginning of April, and the crop is harvested in June. The Little Black Oat is the prevailing variety, although the Texas Red and Texas White are grown. This crop has given way to corn on account of declining yields.

For the twofold purpose of soil improvement and forage production cowpeas are being sown to a large extent. This practice can not be too highly commended, since the cowpeas are decidedly beneficial to the soil both through the addition of needed organic matter and nitrogen gathered from the air. This crop is usually sown between the corn rows at the last cultivation, and is either pastured off or plowed under. The Whippoorwill is the leading variety. The cow-

pea crop often fails to fruit heavily, on which account the seed must necessarily be bought. Better results with fruiting possibly would be had by planting an earlier variety, such as the New Era.

Turnips sown broadcast in the corn land about August afford some stock feed on a good many farms. The varieties well suited for the soils are Purple Top, Strap Leaf, and White Globe.

In a general way the crops of the county are rotated, but not in a systematic manner. Corn is planted year after year until the yields decline, when the field is sown to wheat in which grass is seeded. Grass occupies the land for a number of years. The length of time for which one field remains in a crop depends upon the productiveness of the land. The less productive fields are changed every three years, while some have been in corn for the last 60 years. The advisability of changing the crop on the land is generally recognized, but the value of a systematic rotation is comprehended only by the more progressive farmers. A rotation that would likely prove satisfactory in many fields is about as follows: Corn for two years, with cowpeas planted between the rows; then wheat, followed by timothy and clover for two years. By rotating the crops less dependence would be placed upon the success of one crop and the soil would be improved. In the future development of the agriculture of the county more attention must be paid to this phase of farming.

The value of selecting home-grown seed for planting is beginning to be recognized. Seed selection will fix types or varieties to meet local conditions. Selections of seed corn should be made while the corn is in the field, as a broader view of the nature of the plant can then be obtained.

Commercial fertilizers are not used to any extent. The census of 1900 showed that the county spent only \$1,070 for fertilizers. At the present time the fertilizer question is arousing much interest among the farmers. Nitrogenous and phosphatic fertilizers seem to give better results than potassic fertilizers. Bone meal, acid phosphate, and ground phosphate rock give good results with wheat and corn. The organic matter content of all the soils is low. The growing of leguminous crops, such as cowpeas and clover, and the application of barnyard manure would do much to bring the land into the proper condition.

Chemical analyses by the Missouri Agricultural Experiment Station of some Laclede County soils show that, according to usual standards, the content of nitrogen and phosphorus is strikingly low while potassium is fairly abundant. Field-plot experiments near Lebanon also indicate that nitrogenous and phosphatic fertilizers are very efficacious on these soils. Experiments with wheat in 1907 on plots that received the same treatment, with the exception of the kind of fertilizer applied, gave the following results: The plot

to which nitrogen had been applied yielded 13.1 bushels; the plot receiving nitrogen and phosphorus yielded 18.1 bushels; the check plot without fertilizer yielded 9.6 bushels; phosphorus, potassium, and nitrogen plot, 14.3 bushels; and the lime, nitrogen, phosphorus, potassium plot, 13.6 bushels. These figures represent the results of only one year, and therefore not as much importance can be given them as if they represented the results of a series of years. However, they show conclusively that nitrogen and phosphorus are the elements which are lacking in these soils, and in adopting a rotation and planning the farm practice the aim should be to supply these limiting elements in the largest amounts practicable. The use of potassium as a fertilizer on these soils usually gives only a slight increase. The use of lime will probably not be profitable on any of these soils unless it be on the poorly drained phase of the Lebanon silt loam.

Since a low nitrogen supply usually accompanies a low humus supply, the maintaining of the humus usually means the maintaining of the nitrogen, and, as already indicated, this is most readily done through the use of legumes and barnyard manures.

The best means of maintaining and of replenishing the supply of phosphorus is by feeding the crops to animals and returning the manure to the land and by buying the phosphorus in commercial form. The grain of our common crops contains the largest proportion of phosphorus in the plant, so that when grain is sold from the farm the soil is being depleted of an element in which it is most deficient. In grain farming twice as much phosphorus leaves the land as in stock farming. The advantages of feeding all grain on the farm are therefore obvious. Phosphate fertilizers, usually in the form of bone meal, acid phosphate, or rock phosphate, should always be applied with some kind of a manure. As a rule it is not advisable to apply them to the soil except where ample provision is made for increasing the organic matter, and for preventing loss by erosion; and the phosphorus should not be used as a top dressing, but thoroughly mixed with the plowed soil before seeding down to grass and clover.

According to the census of 1910, the total number of farms in Laclede County is 2,843, with an average of 117.2 acres. Of the total land area of the county, 69.1 per cent is in farms. Of the farm land, 169,012 acres, 50.7 per cent are improved, and 149,958 acres are timberland. The average number of improved acres per farm is 59.4. It is a remarkable fact that the average number of cultivated acres per farm in Laclede County, as well as in all the Ozark region, is less than half as great as in north Missouri, or in any of the prairie regions of the State.

About 35 per cent of the area of the county is in cultivation and the remaining 65 per cent is as yet covered with timber. It is safe to say that about two-fifths of the county consists of nonagricultural land. Such land is characterized by steep slopes and an extremely stony soil. It has its greatest development in the northwestern part of the county along the Niangua River and in the eastern part of the county along the Gasconade River and Osage Fork. Some of this land can possibly be utilized for pasture, but the greater part of it must always remain timberland.

It is estimated that less than half of the land that can be cultivated is now utilized. At least 106,000 acres can be added to the present cultivated area by merely removing the timber from the land. There are as yet large areas of stone free and gently rolling land, mostly of the Lebanon silt loam type, that are timbered, but when cleared will equal in agricultural value the improved land now cultivated. In nearly every case the present cultivated areas can be extended with no additional cost but that of cutting the brush. The most extensive areas that will make good agricultural land are in the northern part of the county. It is on account of these undeveloped conditions that Laclede County offers excellent opportunities for an extension of its agriculture, and when once all of the tillable land is utilized this county will be one of the most important agricultural sections in the whole Ozark region.

At the present time about 65 per cent of the whole area is wooded. Blackjack, black, white, and post oak, hickory, elm, and walnut are the prevailing varieties. Blackjack is the exclusive growth over large areas of the rougher land. Practically all the merchantable timber has been removed and used for building material and railroad ties. About 20,000 railroad ties are now produced annually.

When timber land is prepared for the plow the trees are cut off near the surface of the ground, piled up, and burned. The cost of this operation varies from \$3 to \$10 an acre, depending on the density of the growth. Grubbing out the trees with the roots is rarely practiced. The roots and stump of the trees and brush persist to send up sprouts from 3 to 8 years after the tree has been cut, and to remove them adds greatly to the cost of farming. To remove the sprouts frequently costs more than the original clearing of the land. By planting the land to corn or some crop that needs frequent cultivation and cutting the sprouts once or twice each year the decay of the roots and stumps is hastened and the land is freed from sprouts in a much shorter time—three to five years—than it is if simply pastured. Goats are used by some farmers to clear land of brush, with apparent success. Land that is abandoned for a few years is taken by sassafras and persimmon sprouts, and if these are permitted to grow they will ultimately exclude practically all other growth.

Farms are rented to tenants on a cash or share basis. Rents range from \$2 per acre on the uplands to \$10 an acre for the river-bottom lands. When rented on shares the owner receives from one-half to one-third of the crops, depending on the character of the land, the tenant furnishing the teams and implements. Farm labor is not abundant, but enough hands can be secured for harvesting the crops.

As but few of the townships have a stock law, nearly all of the fields are fenced, besides pastures of uncleared land. The fence posts are of oak and are driven into the ground on account of the difficulty of digging postholes in the hardpan. The fencing consists of a 26-inch woven wire beneath and two or three barbed wires above.

Land values range from \$2 to \$100 an acre, depending upon the agricultural value and the proximity to towns and railroad facilities.

ORCHARDS AND ORCHARDING.

Under the impression that the soils of the county were adapted to fruit, large apple orchards were planted during the period from 1885 to 1890. To-day the commercial orchards comprise from 1,500 to 2,000 acres. The success of orcharding in the area has not equaled that of many other portions of the State; in fact, success may be said to have been indifferent up to the present time. Discouragement and the consequent neglect of the orchards has followed the failures of the crops on account of damage by frost. Abnormally warm weather in March and April frequently forces the buds, which are killed by later frosts. From 1900 to 1906 there was one complete crop failure, while from 1906 to 1910 four failures were recorded on account of frosts.

The most enthusiastic apple men of the county admit that the orchards at the present time are sadly neglected and are in bad condition. The trees are planted too closely and look as if they had never been pruned. Spraying for insects and fungous diseases has never been attempted. The trees are smaller than those in other apple-growing districts. In the hollows the trees show better growth, but in this position are more subject to frosts.

Specialists advise that the orchards be thinned by taking out every other tree and that the remaining trees be top-grafted with scions of Ingram and Minkler, both good market varieties less likely to be injured by frost than the varieties used in the original planting. This step should be followed by trimming and spraying. Forty acres of apples is considered the limit for one man to handle properly. Smudging to protect the trees from frost has been successful in one orchard in the county and no doubt will be undertaken by all the orchardists in the near future.

The apples, when a crop is secured, are bought on the trees by buyers and shipped to St. Louis, where they are placed in cold storage.

The fruit produced, considering the varieties grown, is of good quality and has taken prizes at all the leading expositions and shows of the United States and Europe.

About 75 per cent of all the trees are of the Ben Davis variety. The remaining 25 per cent is divided among the following varieties: Ingram, York Imperial, Gans, Willow Twig, Grimes Golden, Wine-sap, Rome Beauty, Missouri Pippin, Minkler, Huntsman's Favorite, English Rambo, Maiden Blush, Yellow Transparent, Early Harvest, and Wealthy. The Ingram seems to be forging to the front, as it stands cold better than other varieties and is of good quality.

While the extremes of temperature and the frequent occurrence of late spring frosts make the growing of peaches and apples a somewhat uncertain industry, and will not warrant making fruit growing an exclusive industry, it is profitable and probably always will be profitable to carry it on as one part of a varied system of farming.

SOILS.

Laclede County comprises two main physiographic divisions: (1) A high plateau country, such as is developed on the broad plateau-like watershed between the Gasconade and Niangua Rivers; and (2) a belt of country lying along the Gasconade River lower than the plateau country and higher than the narrow river bottoms. The lower belt lies about 200 feet below the plateau level and 300 feet above the river flood-plain level. It varies in width from 1 mile to 5 miles or more. Its western boundary is well defined, but is marked by an irregular line. It extends back into the plateau country up the valleys of small creeks as rather broad, open coves. This boundary enters the county from the south about a mile west of Competition. It runs northward about 2 miles and then turns westward and southward around the head of Big Cobb Creek south of Agnes. West of the latter creek it runs northward again to the township line just north of Agnes and thence extends up Osage Fork as a broad baylike area, fading out a short distance above the mouth of Brush Creek. On the north side of Osage Fork it runs northeastward just east of Russ, Hazel Dell School, and Detherage School to about Wair School, retreating up all the creeks and advancing on all the ridges. From Wair School it bends westward in a broad baylike sweep up Bear Creek to the latitude of Marvin Church. On the north side of Bear Creek it runs in most places less than a mile south of the railway. Between Osage Fork and the Gasconade north of Agnes there are outlying areas of the plateau, though most of the country lies at the lower plain level.

The eastern boundary is a less well-defined line on the ground, the rise up to the plateau level being more gradual than on the western side. This boundary runs southwestward from the eastern boundary

of the county at the line between townships 33 and 34, southwestward to the southern boundary, 5 miles east of Competition.

The Gasconade River, with its tributaries, has dissected the lower belt even more thoroughly than the plateau. Along the outer margin, however, there is usually a narrow belt of smooth country. The coves along the western border where they lie around the heads of small streams are usually smooth also.

The high plateau division embraces flat to undulating or gently rolling plateau country and rolling, ridgy country representing those portions of the original plain that have been dissected by encroaching drainage systems. Some of the ridges have steep slopes and are very narrow on the crests. Also, there are many broader ridges and subsidiary ridges with smooth slopes.

The soils in the main are clearly distinctive in their physical characteristics and topographic position. Over the smoother portions of the highland plane there is developed a series of grayish-brown silty soils, the Lebanon series, which are characterized by the absence of chert except in places where fragments from a lower cherty formation have been worked into the soil by erosional processes or the action of freezes and thaws, and by a yellowish-brown to chocolate-brown, plastic, heavy clay subsoil which grades through a lighter stratum of material mottled yellow and gray or yellow, gray, and red, into a very cherty layer below. The material above the cherty layer is residual in origin, but just what it is derived from is not known. The chert in the lower layer is derived from a cherty underlying limestone. The silt loam, stony loam, and a poorly drained phase of the silt loam were mapped. These were originally prairie soils, but blackjack oak has covered most of the unused lands.

Underlying the silty clay material giving rise to the Lebanon soils is a cherty limestone formation which may include some interbedded, chert-free limestone. Where this formation has been exposed a series of decidedly cherty soils has been found. These appear to belong in the Clarksville series. They lie at a lower level than the Lebanon and are prevailingly rolling and ridgy. Characteristically the surface soils are gray in color and silty in texture; the subsoils are yellow, sometimes grading into red below, and consist largely of silty clay. Three types of soil were recognized, differentiated on the basis of the quantity and size of the chert fragments—the Clarksville gravelly loam, stony loam, and silt loam. The silt loam type is probably derived in part from a chert-free stratum associated with the stratum carrying an abundance of chert. The Clarksville soils are developed over the more rolling portion of the highland division and to a less extent in the low plain division.

Small areas of a black soil having a mottled brown, yellowish, and red plastic heavy clay are represented by the Gasconade silty clay loam. This type is derived from a chert-free limestone underlying the formation giving rise to the Clarksville soils. Some timber is at present seen on the unused areas, but the type was originally prairie.

The Senlon silt loam comprises a colluvial slope type, the material of which has been washed from the adjacent highland types. It is a brown, friable silt loam underlain by brown to reddish-brown silty clay carrying a large quantity of chert in the lower portion.

Rough stony land comprises those rolling and steeply sloping areas which are so exclusively stony and often so steep as to be of little or no value for agricultural purposes. Rock outcrop was mapped in several small areas. It represents what its name signifies, and is not capable of supporting vegetation.

Three series of alluvial soils are represented in the county. The Cumberland silt loam is a stream-terrace soil no longer subject to overflow. It is a brown soil with a red subsoil and represents wash from the various soils of the drainage basins in which it is developed. The material was deposited when the streams were flowing at higher levels. The Huntington series, including the silt loam and gravelly loam, comprise the brown stream-bottom soils which are subject to overflow. Like the Cumberland silt loam, these are derived from the various kinds of material occurring in the drainage basins. The Auglaize silt loam is a black alluvial type, the material of which has been washed largely from the Gasconade silty clay loam.

The various soils mapped are individually described, and their agricultural values and crop adaptations brought out in the following chapters.

The following table shows the actual and relative extent of each type:

Area of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Clarksville stony loam.....	154,880	32.9	Senlon silt loam.....	6,528	1.4
Lebanon silt loam.....	93,760	21.2	Lebanon stony loam.....	6,272	1.3
Poorly drained phase.....	5,888		Cumberland silt loam.....	4,288	.9
Clarksville gravelly loam.....	96,640	20.5	Gasconade silty clay loam....	3,648	.8
Huntington silt loam.....	36,480	7.8	Auglaize silt loam.....	2,816	.6
Clarksville silt loam.....	28,416	6.0	Rock outcrop.....	1,280	.3
Huntington gravelly loam....	19,776	4.2			
Rough stony land.....	9,728	2.1	Total.....	470,400	.....

LEBANON SILT LOAM.

The Lebanon silt loam consists of a friable brownish-gray to grayish-brown silt loam having a depth of about 6 to 10 inches. The sub-

soil is a yellow or brownish-yellow to buff silty clay loam, which grades within 2 or 3 inches into a plastic, tough clay of a yellowish-brown to chocolate-brown color, this in turn being underlain at an average depth of about 24 inches by a more friable layer of silty clay loam of a mottled gray and yellow or bluish-gray and pale-yellow color. A tough "hardpan" layer consisting chiefly of angular chert fragments, in many places cemented with lime or iron and having a mottled red and grayish appearance, is usually reached within the 3-foot section, generally at about 30 inches.

The average depth of the surface soil is very close to 6 inches, but there are places, especially in depressions where there has been some accumulation of wash, where the depth increases to 10 inches. The upper stratum of the subsoil—the thin silty clay loam layer overlying the tough clay—varies somewhat in color, as mentioned, and is not everywhere present, but the tough, plastic clay stratum is always encountered; in fact, it is one of the most marked characteristics of the type. This clay when worked up in wet condition hardens on drying into an impervious, intractible mass, a property which is taken advantage of in making shallow excavations to hold water for cattle.

Chert fragments are practically absent above a depth of about 22 to 28 inches, where some angular fragments are frequently encountered above the hardpan proper.

A different condition is met with where the typical topography gives way to a more undulating surface, or where the type grades into the associated gravelly or stony land. This undulating phase is best developed in the vicinity of Russ. Here the hardpan or gravel stratum is reached at variable depths, sometimes approaching the surface and causing such local areas to be gravelly throughout the entire profile. This condition may also be found along the brows of the slopes of streams or slight drainage courses. In this phase the soil is, in general, similar to that of the typical flat areas, although there are some slight variations. The subsoil is not always so plastic and is more brownish in color.

The Lebanon silt loam is chiefly developed in the western half of the county, the larger proportion of the total area lying in range 16 west, extending from Morgan northward through Lebanon to a few miles from the northern county line. This area extends westward into townships 32 and 33 north to the county line, forming the principal soil type about Conway and Phillipsburg. The type also extends eastward to Russ and Oakland. Areas isolated from the main body are found in the vicinity of Lynchburg and Orla, while many small areas are found in all parts of the county. In a general way the development is continuous, although other types of soil interrupt, as a result of erosion.

The topography of the Lebanon silt loam is fairly uniform. The surface is level to gently undulating, broken only where erosion has taken place. Large areas occur which have a uniformly flat surface. This type lies higher than any of the surrounding soils, and as a consequence the land slopes toward the outer margins of these areas. In a general way the type represents a high plain or plateau forming the main divide between the Niangua and the Osage Fork of the Gasconade River and smaller streams.

This soil gives way to other types as soon as the topography becomes more or less rolling and dissected by erosion. Wherever it is found in large or small bodies the topography is generally flat to gently undulating. In earlier days parts of the type were known as prairies, such as "Fullbright," "Kitty," and "High" prairies. Few streams traverse areas of this soil, for the reason that as soon as a stream cuts into the surface to any depth a different soil type is derived. The drainage of the type is fairly well established, although in the flat areas the surface water accumulates in ponds. The surface relief is scarcely sufficient to establish thorough drainage, while the density of the subsoil checks downward percolation of moisture.

The Lebanon silt loam is derived from a chert-free layer of clay of obscure origin, which overlies the various rock formations of the county. This stratum is very thin, and through erosion much of the original material has been carried away, exposing the underlying rocks to weathering, giving rise to other types of soil. For this reason other types of soil interrupt the Lebanon silt loam, which reaches only so far as the streams have not cut back into the plateau or high plain districts.

The Lebanon silt loam in the early days of settlement was covered with a thick growth of prairie grass, broken by scattered clumps of blackjack oak. The prairie condition was probably the result of fires started by Indians. After settlement began and the lands were brought more and more under cultivation, burning became less common, in consequence of which blackjack and post oak took hold of the unplowed areas. At present much of the blackjack forest is very thick. The clearing of the land is not as difficult as keeping down the sprouts which followed the removal of the timber and which persist for several years afterwards. Much of the land remains covered with the scrubby timber growth.

The Lebanon silt loam is not naturally very productive. It is commonly called "thin land," and by some of the farmers using better soils it is looked upon as worthless. While this soil is not as fertile as other types found in the county, it can be built up to a fair state of productiveness. Corn is the principal crop, the yields varying from around 10 to 30 bushels per acre. The difference in yields is due more to differences in management than to variations

in the soil. Cowpeas are sown in the corn rows at the last cultivation and make a fair growth of vine, but little seed. The production of wheat seems to be decreasing, acreage yields ranging from about 6 to 12 bushels. Grass, consisting of clover and timothy mixed, yields from one-half to $1\frac{1}{4}$ tons of hay per acre.

The low yields secured from much of this soil are due to continued use of the land for corn. Poor soil management, such as plowing the land when wet, has also helped to lower yields. For the improvement of the soil these practices should be stopped and systematic methods substituted. The rotation of crops, in which clover and cowpeas have an important place, should be the first step. The incorporation of organic matter is essential, as the soil sadly lacks humus. This defect is probably the chief cause of the low yields. The cultivation of the soil should be more thorough and complete, as the one or two cultivations now given to corn can not be expected to produce good yields. As much live stock should be kept on the farm as circumstances will permit, the manure being carefully saved and returned to the land.

The subsoil of the type being plastic and impervious, the depth of plowing should vary each time in order to avoid forming a hardpan. Subsoiling would loosen the tightly packed subsoil and afford greater feeding ground for the plant roots. Phosphoric acid should be added to the soil, as this type seems more responsive to phosphatic than to potassic fertilizers. Lime would also be beneficial.

On account of its fine texture and shallow surface soil the type is best suited to the production of grain and grass crops. The topography permits the use of improved farm machinery, which is used at present to some extent. The water supply is uncertain, as no streams are found. The dependence for water is placed upon ponds, wells, and cisterns. Water can be obtained from wells at depths varying from 30 to 100 feet or more.

Lebanon silt loam, poorly-drained phase.—There is considerable variation in this phase, particularly with respect to color. Its differentiation from the typical Lebanon silt loam was based mainly upon the more intense mottling in the subsoil and the poorer drainage.

This soil consists of a dark-brown to nearly black friable silt loam to silty clay loam, ranging in depth from about 4 to 12 inches and becoming lighter in color as the subsoil is approached. The deeper areas are found in the slight depressions. Light brown or gray is sometimes noticed in the surface soil, usually in areas having a more uneven topography and less pronounced mottling in the subsoil.

The subsoil of this phase ordinarily consists of a stratum of grayish-brown plastic clay or silty clay, becoming tougher and more plastic with depth, grading at about 12 to 14 inches into a brownish plastic clay, with a faint reddish cast. At about 18 inches the brown-

ish plastic clay appears mottled with red. Mottlings of gray, drab, blue, and shades of brown come in below and extend to a depth of 30 inches and more. Occasionally the layer having a reddish cast is wanting.

In low places, where water frequently stands, there are some small areas consisting of a gray to grayish-brown silt loam, underlain at about 6 to 10 inches by a plastic, sticky, heavy clay, mottled drab, and yellowish-brown or reddish-brown, the color changing below into mottled yellowish-brown and red, and the texture becoming somewhat lighter. Immediately underlying the clay stratum there is often encountered a stratum about 6 inches thick which consists of a rather crumbly clay or silty clay loam, mottled light gray, drab, and yellow. This material is usually dry, even though the soil and subsoil may be wet and soggy. Everywhere a hardpan stratum of angular chert fragments firmly cemented with iron or lime underlies the phase, usually below 24 inches.

As the phase approaches the typical development of the type its distinctive characteristics gradually disappear, except in the lower portion of the subsoil at depths of 24 to 30 inches, where the mottled material is found.

The Lebanon silt loam, poorly drained phase, is located within a radius of 6 miles southwest of Lebanon. The areas are few in number, but they are usually large. The section of Lebanon township which is locally called "the prairie" is located on this phase of the type.

The topography of this phase is remarkably uniform. The surface is flat, broken here and there by shallow swales, and is more level than the type proper. These soils occur on areas known under local names such as "High Prairie" in the vicinity of High Prairie School and the "Seven Oaks prairie," immediately south of the town of Lebanon. The phase is found only on level land, and as soon as the topography becomes more undulating it grades into the silt loam type. The phase is also found in smaller areas as depressions, representing the heads of streams. Through lack of sufficient surface relief and its impervious clay subsoil the type is poorly drained. The soil is generally cold and soggy, remaining wet and sticky for several days after a rain. Storm waters remain standing in the fields for several days. It is so damp the greater part of the season that a green-moss growth covers the surface. Poor drainage is one of the most serious impediments to the development of the phase, which is derived from the same material as the typical soil. Lack of aeration and oxidation has brought about the mottling in the subsoil. The dark color of the surface has developed through poor drainage preventing the oxidation of the organic matter.

The native vegetation of the poorly drained phase of the Lebanon silt loam consisted of prairie grass, with only here and there a blackjack oak or post oak. After settlement began the blackjack and post oak covered the land with a dense, scrubby growth, and the former is now the predominant tree growth. All of the land is cleared and utilized for farming, owing to the proximity of the town and railroad facilities.

The soil has a low agricultural value, chiefly on account of its poor drainage and the difficulty of handling it. The soil is wet in ordinary seasons and becomes hard and dry in time of drought.

Corn, hay, and wheat form the principal crops, although the last is not grown exclusively. Corn yields from 10 to 25 bushels per acre, although 40 bushels have been produced after a number of years spent in draining and otherwise improving the soil. Hay yields from one-half to 1 ton per acre, and wheat from 6 to 15 bushels. Oats produce from 20 to 25 bushels per acre, although this crop has not been grown to any considerable extent during the last few years. Sorghum and kafir for forage yield from 3 to 4 tons per acre. These crops are not extensively grown.

For the improvement of the soil of this phase draining is necessary. Subsoiling as deeply as possible has proven a decided benefit and should be generally practiced. The use of stable manure is also beneficial. In general the phase should receive the same treatment as the typical soil.

The following table gives the results of mechanical analyses of samples of the typical soil and subsoil and of the poorly drained phase of the Lebanon silt loam:

Mechanical analyses of Lebanon silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
Typical:		<i>Per cent.</i>	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
341725.....	Soil.....	0.9	2.4	3.5	5.5	1.2	68.3	18.3
341726.....	Subsoil.....	.5	1.5	2.3	3.9	1.5	54.0	36.2
Poorly drained phase:								
341710.....	Soil.....	1.1	2.7	1.9	2.2	1.1	69.0	22.1
341711.....	Subsoil.....	.6	1.0	1.1	2.1	.5	46.3	48.1
341712.....	Lower subsoil..	.7	1.1	1.4	2.6	2.2	52.4	39.7

LEBANON STONY LOAM.

The Lebanon stony loam is essentially the same as the Lebanon silt loam, except that it carries sufficient rock fragments to interfere with cultivation.

The soil of this type to a depth of 6 or 7 inches consists of a gray to brownish-gray, friable silt loam, low in organic matter and carrying 20 to 40 per cent of chert fragments of varying sizes up to about 1 foot in diameter. The fine material of the upper portion of the subsoil consists of a yellow or yellowish-brown silty clay loam to silty clay, underlain by a brownish-yellow clay, extending to an average depth of 18 to 22 inches. The subsoil contains about the same quantity of chert fragments as the soil. In the lower 6 inches the gravel content ranges from about 10 to 20 per cent of the soil mass. The larger chert fragments are also more numerous than in the surface soil. Underlying the plastic clay is found a friable silty clay or silty clay loam, from 4 to 5 inches thick and mottled with yellow, drab, and gray. The hardpan, which is reached within the 3-foot section, is the same as found in the silt loam member of this series.

The Lebanon stony loam has a very limited development in the county. The largest areas are found in the eastern edge of the county in township 33 north, range 12 west. Others are found about 4 miles north of Phillipsburg, in the vicinity of Dove and at Bacon School, township 33 north, in range 15 west. Smaller tracts occur throughout the county. The type usually occupies portions between the Lebanon silt loam and the Clarksville stony loam and represents a type intermediate between the two. The topography is level to gently undulating. The surface configuration insures fairly good drainage, but the plastic subsoil arrests downward percolation of moisture and makes the underdrainage poor.

The fine material of the soil has been derived from a chert-free layer of material which occurs only on the highest portions of the plateau or high plain district and overlying the present rock formations. The stones in this type are derived from the underlying cherty formation. They have been disseminated through the soil material probably through the action of freezes and thaws and by translocation from higher lying exposures. As the type is intermediate in topographic position between the Lebanon silt loam and Clarksville stony loam, it practically represents those areas from which erosion has partially removed the former overlying material and exposed the chert fragments of the lower cherty formation in such a way as to cause a mingling of the chert and the original overlying soil.

The vegetation of this type was formerly the same as that of the Lebanon silt loam. At present it is covered with blackjack oak and post oak.

The Lebanon stony loam, once the largest stones are removed, will prove equal in value to the silt loam type. The soil at present is not utilized to any extent for agricultural purposes. The same treatment and method of handling should be applied to this type as to the Lebanon silt loam.

CLARKSVILLE GRAVELLY LOAM.

The Clarksville gravelly loam consists of a gray silt loam, underlain at about 4 to 8 inches by a pale-yellow or yellowish-gray silt loam, carrying sufficient chert gravel and angular fragments ranging up to about 2 inches in diameter, to interfere with cultivation, especially when the soil is dry. Probably 20 to 30 per cent of the soil mass consists of these fragments. When it is dry it is practically impossible to bore into this soil with a soil auger.

The subsoil, beginning at about 8 to 10 inches, is a grayish-yellow or a more decided yellow silty clay loam, grading at an average depth of about 18 inches into silty clay of brownish-yellow to faintly reddish-yellow color. The fine material of the upper subsoil is noticeably friable, but that of the lower portion is slightly compact. In local areas and in places along slopes the lower subsoil is dull red or yellowish red in color, this sometimes coming within 18 inches of the surface. The subsoil carries about 40 to 50 per cent of chert gravel. The subsoil is sometimes locally styled hardpan, on account of the high content of chert. In most of the type a very cherty layer is reached at a depth of about 24 inches. In places this comes close to the surface, while in other places it is entirely lacking. This layer consists very largely of angular chert fragments, usually firmly cemented. Areas having this layer at or near the surface can not be plowed. The very cherty, compact layer has a mottled reddish and gray appearance.

Near the contact with the Clarksville stony loam large fragments of chert are scattered over the surface of this type. The boundary between this soil and the Clarksville stony loam is often difficult to establish, owing to the way the two types grade into each other.

The Clarksville gravelly loam is found in those parts of the county where erosion has dissected the land to varying degrees. The largest areas occur in the eastern part of the county, chiefly between the Osage Fork and the Gasconade Rivers.

This type occupies ridges, slopes, and ravines. The topography is generally very rolling, though there are a few places that are nearly level. Ample drainage is afforded by the surface relief and the open structure of the subsoil. In fact, the type is excessively drained. Topographic features influence the type to a large degree, for on a gently rounded ridge this soil may occur in conjunction with the stony loam member of this series on the slopes, while where the ridges are narrow the stony loam is found and the gravelly loam may be located on the slopes. In general, this type has a more even surface than the Clarksville stony loam. Where the topography is rather rolling the tops of the ridges contain very little surface soil, the underlying gravel being exposed.

The Clarksville gravelly loam is derived from the weathering of a very cherty layer of limestone, the gravel and stones found upon the type representing the impurities of this limestone. Most of the fine material has been washed down the ridges to lower levels and the heavier material, such as chert and stone, remains.

A very small proportion of the soil has been cleared for farming. The native vegetation of this type consists of grass and a scattered growth of timber, chiefly post oak and black jack oak. Since the fires of the early days have been checked a thick growth of post oak and blackjack oak has covered the land. In some places this growth is so thick that it is difficult to penetrate. In other places it is open, but as a general rule the land is thickly covered with a scrubby growth. In the ravines and on the slopes a few black oaks and white oaks occur. Much of this timber has either been utilized for farm improvements or been sold. Some hickory is also found and in the open woods a scant covering of grass.

The Clarksville gravelly loam as a general rule is a soil of medium agricultural value. A small proportion of the type has been cleared for farming purposes. The soil is very shallow and the subsoil is porous, making the type subject to drought. The content of organic matter in the soil is extremely low. Plowing below 4 inches is difficult and in many cases impossible, on account of the gravel. In the rougher districts it is advisable not to plow the land at all, as the loosening of the surface is apt to cause what soil there is to wash away. In the eastern part of the county the cultivated land consists of small fields here and there in the more level tracts. The land on the gentle slopes is utilized for general farming. The type when cleared supports a good growth of grass and is valuable when used in conjunction with better types of soil for grazing.

In the vicinity of Dry Auglaize Creek this soil is more extensively cultivated and yields moderately in good seasons. In dry years the yields are materially reduced. Here the topography is gently rolling and more favorable to cultivation.

Corn yields from 15 to 25 bushels per acre, the higher yield being produced on the better phases of the soil. During moderately wet seasons as much as 40 bushels has been produced. Wheat is not grown to any extent at the present time on account of the low yields. The most urgent need of this soil is organic matter, which is almost totally lacking. By careful methods of management the type could be made to produce better yields than at present.

In Tennessee quite similar soil is successfully used for strawberries, cantaloupes, and Irish potatoes.

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

Mechanical analyses of Clarksville gravelly 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.	<i>Per cent.</i>
341701.....	Soil.....	3.5	3.2	7.2	16.2	4.8	55.4	10.0
341702.....	Subsoil.....	3.3	3.4	6.4	11.9	2.9	59.1	13.0

CLARKSVILLE STONY LOAM.

The Clarksville stony loam consists of 5 inches of light-gray to yellowish-gray cherty silt loam, underlain by a yellow or pale-yellow cherty silt loam to silty clay to a depth of 18 to 24 inches, where it grades into a reddish-yellow or red clay. From 25 to 60 per cent of the soil mass consists of chert fragments ranging in size from small particles to pieces 2 feet in diameter. The surface is thickly strewn with these fragments, the quantity being always sufficient to interfere with cultivation. Within the 3-foot section is usually found a very cherty stratum, sometimes firmly cemented.

This type is the most extensively developed soil in the county. It includes, as mapped, many variations, which are not shown in the map on account of the difficulty of making a detailed separation. The fine material closely approaches that of the Clarksville gravelly loam, the main difference consisting in the greater quantity of stones found in the former type.

In Eldridge, Hooker, and Spring Hollow Townships this type is found in its poorest phase, approaching the general characteristics of the Rough stony land. Here in many places the soil consists chiefly of rock and gravel, with only a small proportion of fine soil material. The few areas of cultivated soil in this section of the county consists of tracts which have been cleared of stones.

In the northeastern section of the county in Mayfield Township this type is found in several large areas having a subsoil of red clay, with a large quantity of rock fragments. Only a small proportion of this land is cultivated, on account of its rough topography.

East of Winnipeg, along the county line in township 34 north, range 12 west, an entirely different condition exists. Here is found the "chunk rock land," which consists of large stones outcropping or lying upon the surface, ranging from 1 to 5 feet in diameter. The type here contains no small rock or chert fragments, nor hardpan, as in other areas. This phase consists of a gray to brownish-gray silt loam of a smooth and friable texture, with an average depth of 8 inches, underlain by a silty clay loam of a yellowish-brown color

extending to a depth of 15 inches, where it grades into a reddish-brown clay, friable, slightly compact, and with a tendency to become sticky. This body is between 2 and 3 square miles in extent. When the stones are removed this land will form good farming land.

The Clarksville stony loam is distributed throughout the county, being extensively developed in those parts which are more eroded. The largest areas lie in the vicinity of the Niangua, Osage Fork, and Gasconade Rivers.

The topography is, in the main, broken and consists of ridges and ravines or hollows. Some interstream areas with smoother topography occur, and here the land has been cleared for farming. The drainage of this type is well established or excessive, and water falling upon the land rapidly runs away. In the few level areas the precipitation which does not run off, quickly passes into the soil. The type is subject to drought.

The Clarksville stony loam is derived through the weathering and erosion of strata of very cherty limestone. The many streams found in the type have cut into the formation, and these drainage courses have carried away much of the finer material, leaving the chert fragments strewn over the land and within the soil mass. The larger quantity of stones and rocks is found on the more broken areas.

The forest growth upon this type is for the most part rather scrubby, although in local areas the growth is heavier. Over the greater proportion of the type post oak, blackjack oak, and hickory are predominant, with here and there a scattering of black oak and white oak. In hollows and on the lower slopes the last-named varieties are more plentiful. In the northwestern part of the county white oak occurs on the top of the ridges, this being the only section where this condition is found. The greater part of the merchantable timber has been removed. The type supports a scanty growth of grass. The Clarksville stony loam is a fairly productive soil in favorable seasons. The most of it, however, must be cleared, and this is difficult and expensive, which tends to discourage its development. Where there is a hardpan stratum near the surface the value of the soil is materially reduced. A very small proportion of the soil is cultivated at present. The remainder is used chiefly as open range for cattle. On the better phases of the type corn yields from 10 to 25 bushels per acre, but the yields depend largely upon the season. Clover and timothy hay yield from three-fourths ton to 1½ tons per acre. Several large apple orchards have been planted. Their success is still uncertain, but in other areas of the State this type has been found well adapted to apples and other fruits.

The chief requirement of the soil is organic matter. It should receive the same treatment as the Clarksville gravelly loam.

CLARKSVILLE SILT LOAM.

The fine earth of the Clarksville silt loam is similar to the fine material of the Clarksville gravelly loam, but the type is a better agricultural land than either the Clarksville gravelly loam or the Lebanon silt loam. The soil portion, which is rather shallow, averaging about 5 inches, and not exceeding 8 inches, in depth, grades from a brownish-gray silt loam in the surface 2 or 3 inches to a grayish-yellow or yellowish-gray silt loam below. In those areas where the soil is shallowest, as on some of the ridges in the southeastern part of the county, the color is yellow or pale yellow beneath the immediate surface 1 inch or so. Occasionally the soil carries an appreciable quantity of fine sand. There is usually present some chert gravel, the content running as high as 10 to 20 per cent in local areas.

The subsoil shows usually three fairly distinct strata, as follows: The upper portion, to a depth of about 12 inches, is a friable silt loam of a light-yellow color; the intermediate stratum, from about 12 to 18 or 20 inches, is similar in character of fine material to the upper layer, but differs in its noticeable content of gravel; and below this intermediate portion a very gravelly silt loam is encountered, carrying in the neighborhood of 40 to 60 per cent of small angular chert fragments of a gray to reddish color. Sometimes a thin layer of yellowish-brown clay is found in the middle section of the subsoil.

This type of soil is easily worked, and the structure throughout is friable. When dry it is fine, loose, and almost incoherent. When wet it is smooth and never becomes sticky, tough, or plastic. Where the very gravelly portion of the subsoil approaches the surface the soil and upper part of the subsoil contain a larger quantity of gravel and are more compact, approaching in this respect the Clarksville gravelly loam, from which the type is separated by a rather arbitrary line. Clarksville silt loam includes only those areas where there is at least 12 inches of a smooth, friable silt overlying the gravelly strata. There are a few local areas in the vicinity of Competition where there is found more than the usual quantity of gravel on the surface and in the soil, but in these areas the percentage is too small to justify a separation as a gravelly loam.

Although the Clarksville silt loam is represented by small areas in almost every part of the county, its main development occurs in the low plain district of the Osage Fork and the Gasconade Rivers. The typical and most extensive area extends from the vicinity of Competition to near Orla. The type is also found around Pine Creek, Lynchburg, Delto, Nebo, Abo, and Hazlegreen. Several large bodies are found in the southwestern part of the county near Conway. Other areas of varying size are located over the county as shown

on the map. Where separation was not practicable or areas were inaccessible, this type was included in the Clarksville gravelly loam.

The larger part of the Clarksville silt loam has a sloping topography. It is found at the base of the ridges which give way to a long, sloping plain extending to small creeks or tributary drainage courses. The slopes themselves are sometimes dissected by stream courses, which produce a gently undulating surface. Since the areas of this type are surrounded or bordered by higher land or ridges, the general topographic features are those of a valley or basin. The soil is locally called "valley land." The type also occurs on ridges where there is a sufficient surface covering overlying the gravel strata to distinguish the type from the Clarksville gravelly loam. In a few instances the topography is nearly level. Here the subsoil becomes more like that of the Lebanon silt loam, and in the level areas the Lebanon type is found. Good drainage is afforded by the sloping surface and by percolation through the gravelly subsoil. In case of drought the crops are affected to some extent, especially where the gravel lies near the surface.

The Clarksville silt loam is derived from a cherty limestone. Part of the soil-forming material has been carried down from higher levels through surface wash.

The characteristic trees found on this type of soil are scrubby oaks, principally post oak and blackjack oak. The heavier timber has been removed. The type also supports at present a few black oaks and white oaks, and hickory makes a better growth than on any other of the upland types. A few elms and walnuts may be seen along fence rows and about the buildings.

The type is considered good farming land in the southern part of the county, and the appearance of the farms indicates a general condition of prosperity. Wheat is grown with better results than on any other of the upland types, the yields ranging from 10 to 18 bushels per acre. Corn is the principal crop, yielding from 20 to 50 bushels per acre, the average being about 30 bushels. By some farmers this type is looked upon as a corn soil almost equal to the river-bottom types. In wet seasons larger yields are produced on this type than in the bottoms, but in seasons of drought the opposite is true. Hay, consisting of timothy and clover mixed, yields from 1 ton to 2 tons per acre. Apples and peaches produce good yields, but are more subject to injury by frosts than on higher locations.

This type of soil, on account of its fine-grained texture and its structure, is better adapted to general farm crops than to special crops. It is a small grain and grass soil.

More attention should be directed to the maintenance and increase of productiveness. The soil is noticeably lacking in organic matter, as is evidenced by its light color. All stable manure should be care-

fully saved and applied to the land. Instead of allowing the straw to lie in the field and rot it should be placed in the feeding lots and stables of the cattle for the purpose of making a larger quantity of barnyard manure. The soil responds readily to the incorporation of organic matter, such as cowpeas. The practice of sowing this crop between the rows of corn and then plowing it under is commendable. The rotation of crops should also be more extensively practiced. Burnt lime applied to the land will be found beneficial, especially to cowpeas and clover.

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

Mechanical analyses of Clarksville 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.	<i>Per cent.</i>
341705.....	Soil.....	1.9	3.1	7.0	12.4	4.1	60.4	11.3
341706.....	Subsoil.....	1.3	3.2	4.0	5.8	2.3	63.7	19.7

GASCONADE SILTY CLAY LOAM.

The Gasconade silty clay loam in its typical development ranges from about 10 to 18 inches in depth and consists of a black, friable, heavy silt loam to silty clay loam, the clay content increasing with depth. The deeper soil occurs in the lower situations, where there has been some accumulation of material washed from above. The loose, friable structure makes cultivation easy, a good seed bed being worked up without much trouble.

The subsoil varies in color, but it is always a heavy clay of decided plasticity when wet. On drying out in exposures it crumbles, as do many calcareous clays. Usually the color is a very dark brown or brownish black in the upper portion, but this quickly gives way to a mottling of brown, yellowish brown, and brick red. With increase in depth grays become more common, while the yellowish and reddish hues become less pronounced. In places the lower subsoil is mottled bluish black and drab.

In the southwestern part of the county (township 33 north, range 17 west) a variation in the mottling occurs, as the subsoil from 15 to 18 inches consists of a brownish-gray clay, mottled with brown, yellow, and red, while at a depth of 24 inches it has a brownish-red color, with yellow streaks. About 3 miles east of Lebanon there is an area in which there are local spots where the subsoil consists of a drab-gray plastic, sticky clay. In general, the distinguishing feature of the type consists of a black soil and mottled subsoil of plastic clay.

The type is derived from a massive, chert-free limestone. Rock fragments, mostly limestone, are scattered over the surface in small

quantities, except near rock outcrops, where they are abundant. These areas were not separated from the general type on account of their limited extent. Fragments of limestone may also be found in the lower portion of the subsoil. Outcropping ledges of rock are a characteristic feature of the type.

The Gasconade silty clay loam is not extensively developed in the county. The most important area is found in the vicinity of Bidwell, where it occupies about 2 square miles. This area is called Benton Prairie. The area next in size is found within a 2-mile radius east of Phillipsburg. Another is found about $1\frac{1}{2}$ miles northeast of Lebanon. Small areas of the type can be found in various parts of the county.

This type has an undulating to very gently rolling surface. It usually occupies the lower portions of the basins, although it is also found on ridges. Along the county line north of Bidwell the topography is nearly level. The surface configuration in general gives ample drainage. In a few places the soil is wet from springs, but this soggy condition is purely local.

As stated, the Gasconade silty clay loam owes its origin to the weathering of limestone, mainly chert free. This stratum outcrops conspicuously throughout the type. It underlies the soil at an average depth of 4 to 8 feet, although it may be found as deep as 40 feet. A few areas of gravelly and stony soils forming isolated patches of a different type occur throughout this type. These represent remnants of a cherty layer of limestone which formerly lay above the chert-free stratum. The type in general is always found where the chert-free stratum of limestone outcrops.

The area of this type in the vicinity of Bidwell represents what was in 1850 a prairie. It supported then a dense growth of prairie grass (bluestem) over 6 feet high. Little timber was found, except in scattered groves. At the present time laurel oak, black hawthorn, honey locust, elm, post oak, walnut, buck bush, wild plum, and wild cherry are common.

The Gasconade silty clay loam is one of the most productive and strongest upland soils of Laclede County. Formerly it was considered a poor soil, as in its virgin condition it was cold and wet. It is later than any of the other upland types. Corn is the chief crop. The average yield is 35 bushels per acre, although yields of 60 bushels are not considered exceptional. Clover and timothy for hay and pasture produce good yields. Wheat, little of which is grown, in favorable seasons produces from 15 to 20 bushels per acre. Winter killing is the chief hindrance to the production of this grain. The type is adapted to oats, although this crop has not been grown to any extent for a number of years.

The soil has been in continuous cultivation to corn and grass since its occupation, and there are at present indications of decreasing productivity. Plowing the land regardless of moisture conditions has helped to bring this about. For the improvement of the soil a systematic rotation of crops, including clover, will be found advisable. Although the soil is of limestone origin, it is likely that lime would be beneficial. Subsoiling to break up the plastic clay, especially where the land is inclined to be wet, should be practiced. These three things—rotation, liming, and subsoiling—all tend to improve the physical condition of the soil. The texture of the soil limits its use to the production of the general farm crops. Improved machinery can be utilized on the larger areas of the type.

The present price of land of this type ranges from \$25 to \$60 an acre, the average being about \$40 an acre. Nearly all of the important areas are taken up and support a prosperous class of farmers.

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

Mechanical analyses of Gasconade 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.	<i>Per cent.</i>
341727.....	Soil.....	0.5	2.6	2.2	4.1	1.6	57.9	31.3
341728.....	Subsoil.....	1.3	2.5	2.2	5.5	1.8	52.6	34.2

AUGLAIZE SILT LOAM.

The Auglaize silt loam is a black, friable silt loam, underlain at an average depth of 14 inches by a heavy silt loam, which grades below into a somewhat plastic silty clay loam to silty clay. The subsoil would be called black, but it is not so black as the soil.

The Auglaize silt loam is not an extensive type in Laclede County. It occurs as narrow bands in the bottoms of a few of the stream courses. It is typically and most extensively developed in the vicinity of Bidwell in sections 4, 5, and 8, township 36 north, range 16 west, where the Gasconade silty clay loam, a soil derived from the same rock, is encountered. The type is also found in the southern part of of the county in the vicinity of the village of Pine Creek 1 mile east of Conway, and along the streams in township 32 north, range 14 west. In the northeastern part of the county small areas are found at the heads of streams flowing into Bear Creek. Other small areas are scattered throughout the county.

The Auglaize silt loam is a stream-bottom soil found along the upper courses of the streams draining Gasconade silty clay loam areas. The former is composed of material washed from the latter.

The areas have a flat topography, with a slight slope toward the stream channel. The type is subject to overflow by spring freshets, but otherwise has fair drainage. In places the soil is wet and soggy from springs, and such areas would be improved by drainage.

The Auglaize silt loam formerly supported a heavy growth of prairie grass. Along the edge of the streams sycamore, elm, walnut, laurel oak, and some black oak were found. The same tree species are found to-day, and blue stem grass also, in the pastures.

Only a small area of this type occurs in the county. It is a strong and productive soil, utilized chiefly for corn and pasture. Corn yields from 40 to 80 bushels per acre, with an average yield of 60 bushels. Tame grasses, chiefly timothy and clover, yield from 1½ to 3 tons of hay per acre. Oats do very well, but have not been grown for a number of years. Wheat is not very successful, as it freezes out during the winter months, besides producing too rank a growth of straw and lodging. In favorable seasons 15 to 20 bushels per acre may be secured. Cowpeas produce a rank growth of vine but no seed.

Below are given the results of mechanical analyses of samples of the soil and subsoil of the Auglaize silt loam:

Mechanical analyses of Auglaize 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.	<i>Per cent.</i>
341731.....	Soil.....	0.9	2.0	1.9	3.7	3.7	66.7	21.0
341732.....	Subsoil.....	.9	2.2	2.3	4.2	2.8	63.9	23.7

SENLON SILT LOAM.

The surface soil of the Senlon silt loam consists of 6 to 14 inches of brown or in places a slightly reddish brown friable silt loam. This is underlain by heavy silt loam to silty clay loam, which rests upon a friable, heavy silty clay, both having the colors of the surface soil, the reddish tinge becoming more pronounced with depth. In general, little or no gravel is found in the surface soil, though where the type adjoins gravelly soils there is more or less of this material along the boundaries.

On the other hand, a large quantity of angular gravel is found in the subsoil at depths varying from 18 to 28 inches, and very few areas were seen in which a gravel stratum was not found into which it was impossible to penetrate with the auger. The depth of this gravel layer varies with the topographic position, being nearer the surface on the higher parts of the benches where the type abuts a gravelly or stony type of soil. Immediately overlying the gravel

stratum there is usually considerable gravel mingled with the subsoil. The gravel consists of angular chert fragments, ranging in size from one-tenth to three-fourths inch in diameter.

The type is found mainly on the slopes or portions of bench lands along the various streams throughout the county. It is generally uniform, though certain variations occur. Near the head of Dry Auglaize Creek, for instance, are small areas where the lower portion of the subsoil shows a dull-red, while local spots such as slight knolls and some of the brows of the slopes or benches where the subsoil is exposed show a bright-red color. Along the Dry Auglaize, in sections 13 and 24, range 16 west, township 36 north, a yellowish-brown colored subsoil closely approaching that of the Lebanon silt loam type of soil is found. Here, however, the friable structure of the subsoil and the vegetation are noticeably different from the Lebanon soil. Similar variations in color may be found in other localities.

The Senlon silt loam is not a widely distributed type of soil, the chief development occurring in various sized areas along Dry Auglaize Creek. As a whole, the areas are long and narrow, conforming to the drainage courses along which they are found. A number of areas are found in Township 35 north, range 14 west, the most important of which lie in the vicinity of Hazlegreen and along Senlon Creek. Two of the largest areas mapped are found north and northeast of Lebanon. The type also occurs along Dry Auglaize Creek and strips too small to map along a number of other streams.

The Senlon silt loam has for the most part a surface sloping gently in the direction of the stream courses, with a gradual fall from the base of the ridges, forming what is commonly known as "bench land." Several areas were mapped along slopes and in swales not adjacent to well-defined stream channels, but such areas are not typical and appear to constitute a colluvial phase.

The surface drainage is usually ample. Erosion is not generally active, although some fields show slight gullies after heavy rains. Much of the rain water is carried away by percolation through the subsoil. The type as a whole is not droughty. The higher portions are more subject to drought than the lower lying, which usually adjoin stream-bottom types.

This type occurs on bench lands, and is more colluvial than residual in origin. The materials of which it is formed are derived from a cherty limestone and have been carried down from the point of derivation by surface waters and by creeping and deposited on the slopes. Some chert-free limestone material also probably enters into the soil, as several outcrops of this rock were found along Dry Auglaize Creek.

Wherever the Senlon silt loam is found the native vegetation differs noticeably from that of adjoining or associated types of soil. Honey locust, walnut, elm, hawthorne, wild cherry, and wild plum are conspicuous, though the most common growth consists of black, white, and post oak. Blackjack oak is also found, but not so extensively as on other types of soil.

In seasons of more than usual rainfall the Senlon silt loam surpasses the bottom land types in crop yields, and the reputed productiveness of the "Glaize" country is partly due to this soil. A farm comprising land of this type and a bottom soil is looked upon as ideal. Corn and grass for pasture are the principal crops. Corn yields from 25 to 40 bushels, with an average yield of 30 bushels to the acre. Wheat is grown to a small extent, usually as a nurse crop for the timothy and clover. Other crops of minor importance are oats, turnips, and sorghum for forage.

With the proper treatment this soil could be used for the production of alfalfa. In this case the land should first be limed. The soil is noticeably lacking in organic matter, which can best be supplied in the form of stable manure or green manuring crops, such as cow-peas, clover, etc., to be turned under. A regular rotation of crops should also be practiced to a greater extent. As to fertilizers, it is advisable to use more ground phosphate rock, or phosphates in any form, than potash. The nitrogen required for the soil should be added through organic matter produced on the farm.

The greater part of the Senlon silt loam has been cleared and put under cultivation. The price of land at present ranges from \$20 to \$60 an acre, depending upon the nearness of town and railroad facilities.

The results of mechanical analyses of samples of the soil and subsoil of the Senlon silt loam are given in the following table:

Mechanical analyses of Senlon 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.	<i>Per cent.</i>
341718.....	Soil.....	1.3	1.6	1.8	4.0	1.1	74.8	15.4
341719.....	Subsoil.....	2.4	2.5	2.0	4.7	2.3	63.8	22.5

CUMBERLAND SILT LOAM.

The soil of the Cumberland silt loam consists of about 8 to 12 inches of brown to chocolate-brown silt loam to heavy silt loam or silty clay loam. This is underlain by a reddish-brown silty clay, becoming heavier in texture and more reddish in color to a depth of about 18 inches. From 18 inches to the limit of the 3-foot soil

profile the red color is quite pronounced, approximating a light brick red. The texture of this section of the subsoil is a friable or brittle clay, with a slight tendency to stickiness. A few subangular or waterworn gravel are found through the soil section. The soil is fairly loose and easily put in good tilth, but becomes compact after lying uncultivated for any length of time.

The Cumberland silt loam is not extensively developed. It is found along streams having a second bottom and is most extensive along the Gasconade River, where an area one-half mile wide and $1\frac{1}{4}$ miles in length occurs. Other bodies are found at different points along this river. The most important occur in the vicinity of Casey Ford, Adams Ford, and 1 mile east of Falcon. The areas along the Osage Fork of the Gasconade River are not as large or as well developed as those along the Gasconade. The largest bodies along this stream are found between Delto and Drynob. A narrow strip occurs along Stearns Creek in the southern part of the county and several small areas are found north of Lebanon along Dry Auglaize Creek. A smaller body is found on the east side of this stream about 1 mile northeast of the town.

The Cumberland silt loam has a level to gently undulating topography. The larger part of the type is nearly level, with only a gentle slope toward the stream channel, yet sufficient to afford drainage for surface waters. The general drainage of the type is good, and it is not subject to overflow. The boundaries between this soil and the first bottoms are marked by a distinct bluff, varying in height from about 2 to 5 feet.

The type owes its origin in part to deposits carried down by the various streams along which it is found when these streams flowed at higher levels than at present. Some of the material forming the soil may also have been carried down from the adjoining hills and ridges by surface water and by creeping. In general the topography indicates that the valley in which the type is found was cut and leveled by the streams flowing through them at an earlier period.

The Cumberland silt loam has been cleared and under cultivation for a number of years. The native forest was similar to that found in the first bottoms, consisting of oak, walnut, hickory, and ash. All these trees attained a good growth.

The Cumberland silt loam is the most highly prized soil in the area. Its productiveness is equal to the first-bottom soil, Huntington silt loam, while it has certain advantages over the latter type which increase its agricultural value. This soil is not subject to overflow and the loss of crops due to this cause, while in case of drought the yields are as good as those on the Huntington soil. Another advantage lies in the absence of the wild morning-glory, a troublesome weed found in the first bottoms.

Corn is the principal grain crop. The yields range ordinarily from 30 to 40 bushels per acre, while 60 bushels is not an uncommon yield. Wheat is not grown to any great extent, although it will yield from 15 to 25 bushels per acre. The grain does not usually produce too rank a growth of straw, although there are times when it lodges. Clovers, including the white, red, and alsike varieties, in combination with timothy, foxtail, and crabgrass, make a good growth for hay and pasturage.

For the improvement of this soil the addition of organic matter is the most important step, as the fields have been planted in corn continuously for a long period and the greater part of the organic matter has disappeared. The application of stable manure and the growing of clover in rotation with other crops are the best methods of upbuilding the soil.

This type of soil would be especially good for dairying on account of its productiveness for forage crops and the plentiful supply of water. The areas are, however, located too far from railroad facilities. At present it is utilized for stock feeding. The topography permits the use of improved farm implements, which are being used at present by many of the farmers.

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

Mechanical analyses of Cumberland 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.	<i>Per cent.</i>
341723.....	Soil.....	0.7	1.8	2.3	3.9	1.6	71.0	18.6
341724.....	Subsoil.....	.9	1.9	1.8	2.9	.7	52.6	39.1

HUNTINGTON SILT LOAM.

The Huntington silt loam to a depth of 12 to 24 inches consists of a friable, smooth, light-brown to dark-brown silt loam. The darker color is usually found in the lower-lying areas, where organic matter has accumulated. Below 24 inches a slightly reddish cast is sometimes discernible. The texture of the material is slightly heavier and more compact in the lower portion, though still a silt loam with smooth, velvety feel. There is thus little difference between soil and subsoil and no distinct line of demarcation.

The type comprises the rich and fertile bottom lands along the numerous streams flowing through the county, and for a bottom soil is remarkably uniform. A marked variation occurs south of Bowmans Ford in section 28, township 33 north, range 13 west, along the Gasconade River, where there is a gentle and scarcely perceptible rise. Here the subsoil consists of a light-brown silt loam,

becoming lighter with depth and containing a few mottlings of brown and red at 24 inches. Below this depth the color is nearly white and the texture heavier. A sour grass grows abundantly on this phase, which is not so palatable as the tame grasses, although the cattle will eat it. This variation in the subsoil is found in several other localities, but in the aggregate the area is relatively small, and therefore it was not separated on the map.

Riverwash, which consists entirely of waterworn gravel and sand, occurs in places as narrow strips along the stream channels within this type or as small islands in the streams. Owing to the slight extent of this material, it was not shown on the map, but was included with the Huntington.

The Huntington silt loam is found chiefly along the Gasconade River and the Osage Fork of the Gasconade, where the areas vary from one-eighth to one-half mile in width, with an average of one-fourth mile. This type also embraces the bottom land along the Niangua River, and Bear, Spring, Prairie, Cobb, Stearns, Brush, and Dry Auglaize Creeks. It is also found along smaller streams, but not so extensively, as along these smaller streams it grades into the Huntington gravelly loam, a closely associated type.

The surface is flat, with a slight slope toward the stream channel. Slight terraces are found at various points within the first bottom itself. Along the smaller streams, where the valleys are narrower, the slope is more pronounced. The type is subject to overflow, the lowest lying areas being flooded with a 2 to 4 foot rise in the streams. At many points along the streams, however, no serious damage results from a 10-foot rise. Under normal conditions the land is well drained. Local areas would be benefited by tile drainage. The water table lies below 3 feet as a general rule.

The Huntington silt loam is distinctly alluvial, having been carried down from the hills and slopes by the action of running water and deposited in times of overflow. Each overflow adds new material to the soil, and in this manner the high productiveness of the land is maintained.

At present the Huntington silt loam is cleared and under cultivation. The original forest consisted of black walnut, butternut, white hickory, sugar maple, chinquapin oak, ash, bur oak, pawpaw, sycamore, and water oak. These trees are to-day found only along the stream courses, where the sycamore predominates.

The Huntington silt loam, with the exception of the less extensively developed Cumberland silt loam, a second-bottom type, is the most productive soil in the county. The first settlements were made on this type of soil, and it has been under constant cultivation since that time, with little change in the yields. It is the best corn and grass land of the county. Fields that have been continually in

corn for 60 years yield 40 to 50 bushels per acre at the present time. The average yield of corn is about 40 bushels per acre, although the yields run as high as 80 bushels in some fields. Timothy and clover hay yield from $1\frac{1}{2}$ to 2 tons per acre. Wheat is not grown to any extent, as it lodges and produces a rank growth of straw and a small amount of grain. Under the best conditions it has yielded from 15 to 20 bushels per acre. This type of soil is considered to be more productive in dry than in wet seasons, as during the latter the water table rises too near the surface. Good crops of grass and corn have been produced with scarcely any precipitation.

The weeds found upon Huntington silt loam offer the greatest difficulty in its cultivation. The seeds are deposited by the overflow waters and for this reason previous cultivation, however careful and thorough, makes little difference. There are instances where the weeds have crowded out grass after the second or third year. The wild morning-glory is the worst weed to contend with, as this plant frequently overruns an entire cornfield by twining from one stalk of corn to another. Cocklebur, smartweed, and careless weed are also troublesome.

The Huntington silt loam ranges in value from \$40 to 80 an acre, \$60 an acre being about the average price.

HUNTINGTON GRAVELLY LOAM.

The Huntington gravelly loam consists of 12 inches of friable, smooth, brown, silt loam, containing from 20 to 30 per cent of gravel and large chert fragments, underlain by a light-brown, medium, compact but friable silt loam, becoming lighter in color at depths below 18 inches. The subsoil, as a rule, contains more gravel than the surface soil. The light color is due in a large measure to the absence of organic matter.

The gravel found in this type consists of partially rounded and angular chert fragments, ranging in size from one-eighth of an inch to 2 inches. The gravel is irregularly distributed and in many cases it was difficult to separate the gravelly loam and the silt loam types.

The general distribution of the two types is shown on the map, from which it will be noticed that the Huntington gravelly loam is well distributed in all parts of the county, usually along the smaller streams. The long and narrow strips of this soil type represent narrow hollows or ravines.

The topography of the Huntington gravelly loam is flat, with a slope toward the stream along which it is found usually sufficient to insure good drainage. As the type occurs along the intermittent streams, it is not as subject to overflow as the Huntington silt loam, through which larger or permanent streams flow.

The Huntington gravelly loam is principally alluvial in origin, but some colluvial material enters into its composition in the

shallower drainage ways. The soil material is derived from residual soils coming from cherty limestone. The material has not been transported any great distance, and the large fragments of chert have been carried along with the fine earth.

The Huntington gravelly loam has been cleared and in cultivation for many years. The native timber growth consisted chiefly of white hickory, ash, white oak, black oak, some sycamore, and water oak. Prairie grass, or bluestem, grew abundantly in the prairie hollows. Groves of black walnut and butternut are found in a few places at present. Hawthorn and wild plum are common. Buck bush is commonly found along the roads and fences.

The Huntington gravelly loam is a fertile and productive soil. It is, in fact, the type of soil, in the northwestern townships and in all the more dissected districts of the county, on which the farmers depend for their grain. It is utilized for corn production almost to the exclusion of other crops, the yields ranging from 25 to 60 bushels, the average yield being approximately 40 bushels per acre. Cowpeas are planted between the rows of corn and are pastured by hogs. When seeded to grass the yields of hay range from 1 ton to 3 tons per acre. Wheat is grown to a limited extent, the yields averaging about 15 bushels per acre. This type of soil is especially recommended for tomatoes, which give excellent yields of high-grade fruit. A very small acreage of this soil is used for pasturage purposes, as the less fertile hills adjoining supply sufficient grass for this purpose. The type is an excellent grass soil.

Although the type is productive at the present time, its fertility has decreased perceptibly during the last few years. This is a natural result of continuous cropping to corn for a long period of time. The rotation of crops should be more extensively practiced. Sowing cowpeas between the corn rows is recommended, and the turning under of organic matter in the form of stable manure or green vegetable matter will be found of benefit to crops.

ROUGH STONY LAND.

The Rough stony land mapped in the county consists of those areas which are stony and broken to such an extent as to be of no agricultural value. They comprise mainly the steep sides of the ravines along many of the streams. Cultivation of these areas would be impossible, as the slopes are too steep and the stones too numerous and large, and if cleared and plowed the fine material would wash away under a slight rainfall. Many rocks outcrop in this type, which also includes several of the more extensive bluffs along the various stream courses.

Extensive areas of Rough stony land are found in the northwestern part of the county, where erosion has been most active. The streams

here have cut their channels to a depth of 100 feet or more. The slopes of these ravines are almost precipitous.

The type supports a growth of post oak, white oak, and black oak. Much of this timber remains on the land on account of the difficulty of removing it. A scant growth of grass is found, which serves for pasturage. This land should be allowed to remain in timber or be utilized for forestry purposes and for such pasturage as may be secured.

ROCK OUTCROP.

Throughout the county small bodies of land consisting entirely of rock outcrop have been mapped. These areas are of no agricultural value, as no vegetation is found upon them. They occur on the rolling lands on the tops or sides of the ridges. Many of them are too small to be shown on the map, and in order to show others their size was slightly exaggerated. The largest area, comprising about 115 acres, occurs about $1\frac{1}{2}$ miles northwest of Bidwell, where a chert-free, massive limestone stratum outcrops conspicuously. Another area in this section covers about 40 acres. The smaller areas range from 5 to 15 acres in extent.

SUMMARY.

Laclede County, Mo., is located in the south-central part of the State, in the Ozark Plateau, and has an area of approximately 735 square miles, or 470,400 acres. The topography is undulating to roughly rolling. It is drained by the Gasconade and Niangua Rivers and their tributaries. Lebanon is the principal town and county seat. The county was settled in the early part of the nineteenth century, the first settlers coming from Tennessee and Kentucky. In 1910 the population was 17,363.

The St. Louis & San Francisco Railroad is the only railroad in the county, and the farthest point from the railroad is 35 miles. The county roads are poor. All parts of the county are connected by telephone, and the rural free delivery of mail reaches all sections.

The climate is temperate. The winters are open, and periods of cold weather continue for only a few days. Abnormally warm weather in the latter part of winter followed by cold periods has proved a hindrance to fruit growing. The growing season extends from April 15 to October 15.

Stock raising was the first agricultural pursuit, followed by small-grain farming. Corn is the chief crop, the yield for 1900 amounting to 837,240 bushels. Wheat ranks second, with oats, cowpeas, and hay in the order named. Stock raising and feeding is an important industry on the fertile river-bottom lands. Insufficient corn is grown to feed the cattle handled.

In 1910, 69.1 per cent of the total area of the county was in farms, and of this 50.7 per cent was improved. The average size of the farms is 117.9 acres, and 63.1 per cent of the farms are operated by the owners.

The cultural methods are more or less varied, as a result of the farmers trying to readjust the type of farming to modern conditions.

The agriculture of the area shows development in the use of improved methods and implements. The soils, as a rule, are deficient in organic matter and phosphorus. Crop rotations, selection of seed, application of stable manure, turning under of leguminous crops, are the chief essentials for the improvement of the soils.

Orcharding is still a questionable venture, as the recent failures have tended to discourage fruit growers.

The soils are the result of the weathering of cherty, bedded rock formations and chert-free massive rock. All the rocks are limestone. Alluvial soils are found along the water courses. The upland soils are residual. All the soils fall within the silt loam and silty clay classes.

Eleven soil types and one phase were mapped in the county, besides Rock outcrop and Rough stony land, which are nonagricultural soils. The agricultural types fall into eight series.

The Clarksville series is represented by the gravelly loam, stony loam, and silt loam types. The gravelly loam and stony loam are not farmed to any extent, but are used for pasture. They are both rolling and excessively drained. The silt loam is one of the best upland soils, occupying a sloping topography.

The Lebanon series comprises the Lebanon stony loam and the Lebanon silt loam, the latter being extensively farmed on account of its level surface and its location in close proximity to a railroad. It is not a soil of great natural productiveness, but can be built up. The poorly drained phase of the Lebanon silt loam is a flat soil, poorly drained and of low productiveness.

The Gasconade silty clay loam is derived from a chert-free massive limestone. It is productive, but limited in extent.

The Senlon silt loam is a bench-land soil of great productiveness.

The Cumberland silt loam is a second-bottom soil and the most desirable type of the county.

The Huntington series is represented by the silt loam and gravelly loam types. These are first-bottom soils and produce the greater part of the crops of the county. These soils were the first to be taken up and have been intensively cultivated to the present time. They are dark-colored alluvial soils of high fertility.

The Auglaize silt loam is a black alluvial soil, the strongest alluvial type of the area, but of limited extent.

[PUBLIC RESOLUTION—No. 9.]

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

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

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

Approved, March 14, 1904.

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

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