SOIL SURVEY OF COOPER COUNTY, MISSOURI.

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DESCRIPTION OF THE AREA.

Cooper County lies approximately in the center of the State of Missouri, its southeastern corner being about 115 miles in a direct line from Kansas City, 125 miles from St. Louis, the same distance from the Iowa line on the north, and less than 150 miles from the Arkansas line on the south.

Meridian 93° west longitude and parallel 39° north latitude intersect near Blackwater, in the northwestern part of the county. In

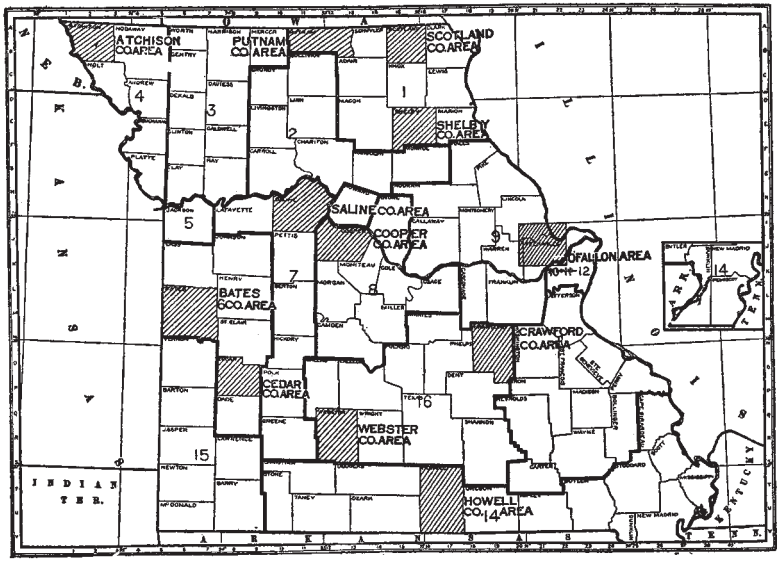

FIG. 44.—Sketch map showing location of the Cooper County area, Missouri.

latitude it is intermediate between that of St. Louis and Kansas City, St. Louis being due east of the southern part of the county and Kansas City due west of the northern part.

The Missouri River forms the northern boundary of the county. On the east lies Moniteau County, on the south Moniteau and Morgan counties, and on the west Pettis and Saline counties. The county comprises approximately 359,040 acres, or 561 square miles.

As compared with the level prairie regions of the northern or western part of the State, Cooper County may be considered rough,

although portions of the county are comparatively level. The largest of these level portions extends from the high prairie in the south-central part of the county to the north and east, passing beyond the county boundary east of Prairie Home and forming the watershed between Moniteau Creek on the south and Petite Saline Creek on the west and north. In the vicinity of Lone Elm this body of upland widens into the most extensive level region to be found in the county. Other important extensions occur between the east branch of Petite Saline Creek, called Stephens Branch, and the west branch of the same stream and also between the west branch and the Lamine River. A third extension of it is found between Clarks Fork and Cave creeks in the eastern part of the county. In addition to these larger bodies of level upland there are many small detached areas, the largest of these occurring along the western and southern boundaries of the county.

These level stretches have a uniformity of slope, and wherever eroded at their edges show a similarity of underlying structure, which seems to indicate that they may be only fragments of a continuous plain which formerly extended over the entire area. This plain, judging by the fragments remaining, had at its highest point, near the southern part of the county, an elevation above sea level of about 950 feet and sloped gently to the north and east, where the highest points remaining have an elevation of about 800 feet.

Into this plain deep valleys have been cut by several large streams and their tributaries, until at present the only parts remaining are these elongated level stretches which separate the drainage systems of the larger streams and the tonguelike ridges which, extending from these, stretch between the upper courses of the smaller tributaries.

The highest remnant of the old plain in the northern part of the area has an elevation of about 850 feet, while the elevation of the flood plain of the Missouri River, which marks the lowest point to which erosion has been carried, is a little over 600 feet, so that all slopes, whether gradual or abrupt, are limited by these two levels. Along the larger streams the hills are in places quite steep and approach the maximum limit in height, but over the greater portion of the area they are much lower and are usually not too steep for cultivation. Even where they are not cultivated this is due in many places to the stony surface rather than to steepness of slope. Over this entire undulating area, however, the process of erosion is going on rapidly and the eroded material is being carried into the Missouri River or deposited along the flood plains of its tributaries.

The largest of these tributaries in Cooper County is the Lamine River. The largest tributaries of the Lamine are Blackwater River and Heaths Creek, which enter it from the west, but drain a terri-

tory almost entirely outside the county, and Otter Creek, Honey Creek, Clear Creek, Skull Creek, and Choteau Creek, which enter it from the east and south. The Lamine River with its tributaries drains more than one-fourth of the county. The stream which has the largest drainage area, however, within the county is Petite Saline Creek, which with its tributaries drains almost one-half of it. Entering the Petite Saline Creek from the south are numerous tributaries, the largest of which are Stephens Branch, Clarks Fork Creek, and Cave Creek, while from the north are Lick Branch, Alexander Branch, and other smaller tributaries. The southeastern portion of the county is drained by Moniteau Creek, which has its source near Tipton. Its principal tributary from the south is Brush Creek and from the north Pisgah Creek.

Each of the larger streams is bordered by comparatively level flood plains, over which the water spreads during periods of flood. The Lamine River bottoms are the broadest and best developed, the width for its entire length within the county, a distance of about 30 miles, averaging nearly three-fourths mile. Through this flood plain the Lamine follows a meandering course, changing it here and there in time of flood and leaving long, narrow U-shaped lakes to mark its former course. Narrow flood plains extend along Petite Saline and Moniteau creeks and their tributaries.

In addition to the creek and river valleys which cut into the plain that formerly extended over the whole area comprised by Cooper County, there is a belt of lowland country extending east and west across the northern part of the county. In the western part of the county it is not well enough defined to be noticeable. It begins as a definite lowland belt in the neighborhood of the junction of Lamine and Blackwater rivers, where it has an elevation of about 60 feet above the flood plain of the Lamine. From Lamine station eastward to the Boonville and Sedalia road its floor is nearly flat, the country south of it rising about 100 feet and that to the north not more than 60 or 70 feet above it. East of the road it is followed by the Petite Saline Creek and its tributaries. The main stream has cut a valley in it to the depth of nearly 100 feet.

This does not seem to be an old high-level valley of the Lamine River, as has been suggested by Todd, but merely a stretch of low country lying along a belt of soft Coal Measure shales, clays, and sandstones, with the harder limestones of the Mississippian series on each side of it. In a few places, owing to the depth to which the soft rocks extend, the bottom of this belt is nearly as low as the Petite Saline bottom land.

Five miles south of Blackwater, 2 miles west of Chouteau Springs, 2½ miles northeast of Clifton City, and in a few other places there are short stretches of valley, floored with alluvium. They are the former valleys of the streams near them that have been abandoned.

Stream terraces, or second bottoms, are also well developed in many of the stream valleys, especially along that of Petite Saline. Here the existing flood plain is bordered by a terrace 20 or 30 feet in height, above which is another level, well-defined flood plain usually spoken of as second bottom. These higher flood plains were formed during some previous stage of the stream's development.

The region including what is now Cooper County at an early date attracted the attention of hunters, trappers, and pioneer settlers. They were principally from Kentucky, Virginia, and Tennessee, although other sections were represented, and reached this region by way of the Missouri River. Settlement proper began in 1810, the first settlers coming across the river from Howard County and others from older settlements farther down the river. Within a few years scattered settlements were to be found throughout the timbered portions of the county. Many of the present settlers are the descendants of families that have lived in the county for more than three-quarters of a century.

These early settlers selected the timbered portions of the county principally on account of the supply of wood for fuel and building purposes, the existence of good springs, and the abundance of game, but, coming as they did from other timbered regions, they supposed the prairies were of no value, except for grazing purposes. About 1830, however, a few settlers tried growing crops on the prairies, and so successful were they that settlement soon spread over the prairie as well as the timbered section.

Early in the history of the county a few Germans came to the region, settling principally in and around Boonville. Since 1870, however, the influx has been much more rapid, and at the present time they constitute a large part of the entire population, some communities being almost entirely German.

Cooper County had, in 1910, according to the United States census, a population of 20,311, of which nearly three-fourths lived on farms and a large portion of the remainder in towns and villages of less than 900 population.

The largest town in the county is Boonville, on the Missouri River, in the northern part of the county. It is the county seat and has, according to the census of 1910, a population of 4,252. It is located on two lines of railroad and has manufacturing interests of importance. Bunceton in the south-central part of the county, Pilot Grove in the west-central part, Prairie Home in the eastern part, and Blackwater in the northwestern part, are prosperous and growing towns, each surrounded by a rich farming country. Otterville, in the southwest corner of the county, Clifton City, a few miles north of Otterville, Pleasant Green, south of Pilot Grove, and Wooldridge, in the north-

eastern corner of the county, are smaller railroad towns. Many other post offices and villages are found in the county.

During the early period of settlement Cooper County was, for that time, well supplied with means of transportation because of its location on the Missouri River, and this fact had much to do with its rapid development. Prior to the advent of the railroads and for some years afterwards many steamboats plied the Missouri between Kansas City and other upriver points and St. Louis, and old records show that for a long period of years the landing of boats at Boonville was a matter of almost hourly occurrence. During recent years, however, river transportation has declined, until at the present time there are no boats making regular trips. A company with a large capital has recently been organized, and the outlook for a resumption of river traffic is promising. The county is well supplied with railroads. The main line of the Missouri Pacific Railway practically parallels the southern boundary line of the county at a distance of about 2 miles. The River Route of the same line extends east and west across the northern part of the county, following the Missouri River from Wooldridge to the mouth of the Lamine. Both of these lines afford direct communication with St. Louis and Kansas City, the former being 170 and the latter 119 miles from Boonville. A branch line leased by the Missouri Pacific passes north and south through the central part of the county, connecting with the main lines at Boonville and Tipton. The main line of the Missouri, Kansas and Texas passes diagonally through the county from Boonville on the north to Clifton City on the southwest, affording a good route to Chicago. The only region which is of any considerable distance from shipping points is that in the vicinity of Prairie Home, some portions of which are as much as 10 miles from the railroad.

The older public roads in Cooper County were laid out along the ridges, regardless of land lines, and owing to roughness of topography in many parts of the county this method is still followed to a considerable extent. These ridge roads and also the principal roads on the level uplands are well graded and have been greatly improved during the past few years.

The rural free delivery of mail and the telephone service reach all parts of the county, and almost every farmer has the advantage of these improved means of communication.

CLIMATE.

The climate of Cooper County does not differ essentially from that of other parts of central Missouri, being a little more equable perhaps than that of the level more open country north and east of it and probably less so than that of the more broken country a short distance to the south.

The average date of the last killing frost in spring is about the middle of April and of the first in fall about the middle of October, thus giving a growing season of six months. During late spring and early summer the weather is often quite hot, but the rainfall during this season is usually sufficient to prevent injury to growing crops. The late summer and early fall are drier, offering ideal conditions for ripening crops. The winters, although at times quite cold, are not as a whole severe.

The annual rainfall for this region averages about 40 inches, almost two-thirds of which occurs during the growing season.

The principal injury to crops resulting from climatic conditions consists of damage to fruit by severe frosts following abnormally warm weather in early spring; delay in the planting or cultivation of spring crops, caused by continued periods of wet weather in the spring, followed by periods of hot, dry weather; and injury to winter wheat, when unprotected by snow, from repeated freezing and thawing. As a whole, however, the seasons are favorable not only for the production of harvested crops, but also for the growth of pasture grasses, which in this region are of almost as much importance. Crop failures or even very short crops are almost unknown.

The climatic data in the tables below are compiled from the records of the Weather Bureau stations at New Palestine and at Columbia. Though Columbia is situated in Boone County, which lies on the opposite side of the Missouri River from Cooper County, the figures for that station, as well as those of New Palestine, are fairly representative of the climatic conditions of the area surveyed.

Normal monthly, seasonal, and annual temperature and precipitation at Columbia and New Palestine.

Months.	Columbia.							New Palestine.	
	Temperature.			Precipitation.				Temperature.	Precipitation.
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for driest year.	Total amount for wettest year.	Snow, average depth.		
	°F.	°F.	°F.	Inches.	Inches.	Inches.	Inches.	°F.	Inches.
December	34	75	−23	1.8	2.3	2.3	3.1	33.2	2.01
January	31	74	−16	2.2	2.3	2.3	5.0	31.4	1.53
February	30	76	−26	2.2	1.8	6.8	5.2	45.8	2.75
Winter	32	.....	.....	6.2	6.4	11.4	13.3	.....	.....
March	42	85	− 6	3.1	3.2	3.5	3.5	55.7	3.98
April	56	90	18	3.8	2.4	5.6	0.7	66.1	4.54
May	65	92	30	4.9	0.4	10.6	0.0	73.2	4.94
Spring	54	.....	.....	11.8	6.0	19.7	4.2	.....	.....

Normal monthly, seasonal, and annual temperature and precipitation at Columbia and New Palestine—Continued.

Months.	Columbia.							New Palestine.	
	Temperature.			Precipitation.				Temperature.	Precipitation.
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for driest year.	Total amount for wettest year.	Snow, average depth.		
	°F.	°F.	°F.	Inches.	Inches.	Inches.	Inches.	°F.	Inches.
June	74	104	42	4.8	1.2	3.6	0.0	77.6	4.27
July	77	111	45	4.4	2.7	7.6	0.0	77.2	3.84
August	76	105	42	3.1	1.7	3.6	0.0	70.1	4.23
Summer	76	.....	.....	12.3	5.6	14.8	0.0	.....	.....
September	69	104	26	3.4	1.4	4.5	0.0	59.5	2.33
October	58	95	19	2.1	1.2	1.9	0.0	45.5	1.79
November	43	80	5	2.2	0.8	2.4	0.6	34.8	1.55
Fall	57	.....	.....	7.7	3.4	8.8	0.6	.....	.....
Year	55	111	−26	38.0	21.4	54.7	18.1	55.8	37.76

Dates of first and last killing frosts at New Palestine.

Years.	Last in spring.	First in fall.	Years.	Last in spring.	First in fall.
1901	May 26	Sept. 18	1906	May 9	Oct. 10
1902	.....	Oct. 14	1908	Apr. 30	Nov. 5
1903	May 1	Oct. 18	Average	May 4	Oct. 15
1904	Apr. 17	Oct. 23			

AGRICULTURE.

Cooper County is essentially an agricultural region. It has an area of less than one one-hundred-and-twentieth of the entire State and only one one-hundred-and-thirty-seventh of the population, yet in 1908 it produced one one-hundred-and-twenty-seventh of all the corn, one forty-first of the wheat, and one sixty-eighth of the total farm crops. It also produced one sixty-sixth of all the hogs, one seventy-eighth of the poultry and eggs, and one-eightieth of the total live stock. The estimated value for the total live stock for the same year was $1,435,753, for the poultry products $571,324, and for the farm crops $518,911.[a]

The principal crops are wheat, corn, clover, timothy, oats, and rye. Cowpeas are being introduced in many parts of the county and the growing of alfalfa is receiving some attention. Tobacco was once

[a] Missouri Bureau of Labor Statistics, 1909.

grown to a considerable extent, but after the civil war was practically abandoned. During the last two years, however, this crop has received attention and gives promise of becoming one of the important crops. Orchard fruits, small fruits, and garden products of considerable value are also produced.

The agricultural importance of the county depends very largely, however, upon its live stock. It is one of the leading counties of the State in the production of purebred Shorthorn cattle, while its horses, mules, sheep, and hogs are, as a whole, of high grade.

During a large part of the year this stock is kept on the splendid bluegrass pastures found in almost all parts of the county and with the exception of wheat, practically all the farm crops grown within the area are fed to the live stock.

In 1900, according to the United States census, there were in the county 2,664 farms having an average size of 127 acres. Two-thirds of these were cultivated by owners or part owners. Owing to prosperous conditions the number of owners has probably increased since that time. The price of the best farm land has also advanced during this period from $40 or $50 in 1900 to from $60 to $100 an acre in 1909 and considerable land is being sold at these higher prices. The more broken and stony land ranges in price from $20 to $40 an acre.

As a whole the farm practices in Cooper County are good. In addition to feeding the larger part of the crops, which always tends to maintain the soil in a higher state of productiveness than where such produce is sold, attention is given to the rotation of crops, the saving and applying of manure, the improvement of seed, introduction of new crops, better methods of cultivation, and the other elements which go to make up successful farming. Much more must be done, however, if the farmers are to continue as prosperous as at present and if the soils are to retain their present state of productiveness.

The recognized wheat soils are the loess soils in the northern part of the county and the deeper portions of the limestone soils farther south. Fultz and Redchaff are the principal varieties grown and the yield from the better wheat lands ranges from 15 to 18 bushels per acre.

When wheat follows corn the corn is cut as early as possible, the ground disked and harrowed, and the wheat drilled in. When it follows small grain the ground is plowed as early as possible after the crop is removed and thoroughly worked to pack the subsoil and then left with a loose but well-pulverized surface mulch to hold the moisture until sowing time. When it is intended to follow wheat with timothy or clover, timothy is sown with the wheat or later in the fall and clover on the wheat early the next spring.

Commercial fertilizers are used to a small extent, and their use is increasing. When the land is in a good state of tilth, the greatest benefit will probably be derived from bone meal applied at the rate of about 150 pounds to the acre with wheat. When the ground is somewhat run down a complete fertilizer will probably be found more beneficial.

The improvement of corn is receiving much attention in Cooper County and the impression is general that the yield per acre is increasing, owing to the use of better seed and better methods of handling the crop.

The best corn soils are found in the black level uplands and in the river bottoms, although good corn is grown on soils in other parts of the county. The favorite varieties are Reids Yellow Dent, Boone County White, and Cartner. The average yield for the better corn sections is nearly 50 bushels per acre. The greater portion of the corn is checked and cultivated both ways. Two-row cultivators are coming into use.

Clover is one of the most important crops of the area both for feed and for its value in building up the soil. The seed crop is often of value, too. Clover can be grown on any soil of the area, but does best on the wheat soils. On the flat areas, where the soils have a heavy clay subsoil, it freezes out badly.

Cowpeas are also valuable for feed and for their effect on the soil. They may be drilled between the rows of corn after it is laid by or may be put in as a separate crop. They are especially valuable in building up badly run-down land.[a]

Several efforts have been made in different parts of the county to grow alfalfa, but with less success than might be hoped for. This is believed to be due, however, rather to the lack of understanding of the requirements of the plant than to soil or climatic conditions. The bottom land soils and wheat soils, if properly handled and maintained in a good state of productiveness, should undoubtedly grow good alfalfa.[b]

Tobacco growing is a new industry for the present generation of this region, but the results obtained the past two years are encouraging. White Burley is grown exclusively, and an average yield of about 1,500 pounds per acre has been obtained. The loessial and better limestone soils are used for this crop.

Fruit growing has received considerable attention at various times in Cooper County, and many apple orchards of from 5 to 40 acres

[a] Monthly Bulletin No. 9, Growing Cowpeas in Missouri, issued by the Missouri State Board of Agriculture, gives much valuable information on this subject.

[b] Bulletin No. 72, Alfalfa Growing in Missouri, issued by the Agricultural College of the University of Missouri, gives a very thorough discussion of this subject, with results obtained from numerous experiments in the State.

have been set out, but the business has not been very profitable, and most of the orchards are at present badly neglected. This lack of success is not due to the soil, for both the loess and the deeper limestone soils are excellent fruit soils. The climate is usually held to be the cause of failure, but this is true in part only, and if orchards are properly cared for the yields and quality of fruit can be materially improved.

Some attention has been given to the growing of strawberries, bramble berries, and garden truck in the vicinity of Boonville.

Near Gooch Mill and at Wooldridge several acres of tomatoes have been grown for the past two years to supply small canneries, and have given good returns. The loess soils and some of the bottom-land soils, especially those along the Missouri River, are excellent small-fruit and trucking soils, and this industry can, with profit, undoubtedly be very greatly increased.

Although the growing of clover and the feeding of stock has done much to keep the soils of Cooper County productive, many fields have declined decidedly in yields as a result of the constant planting of one crop, usually corn, and the removal of much of the best soil from the surface by erosion.

The effect of erosion in a cultivated field is not usually appreciated until ditches too deep to be crossed by farm machinery begin to appear. It is taking place, however, wherever the surface of the soil is left unprotected and the slope is sufficiently steep to carry off the water which falls on it, and this constitutes one of the greatest of losses to farm lands.

This can be checked to a considerable extent by deep cultivation, which will make the soil loose so that it can take up the moisture more rapidly, by keeping the surface covered with a crop during as much of the year as possible, by cultivating across instead of up and down the slope, and by filling small washes as soon as they appear with straw or brush.

In a region so well drained it would seem that artificial drainage would be unnecessary, yet there are limited areas in all the larger stream valleys and also near the heads of many of the small streams where a good system of tile drains would prove beneficial.

It is estimated by the agricultural experiment stations that when all crops are fed and the waste returned to the soil by feeding directly upon the land or by saving and applying the manure with a spreader, that between 60 and 70 per cent of the essential elements are returned to the soil. Another method of maintaining the fertility of the soil is through the rotation of crops. It has long been known that when any crop has been planted on the same soil for several years in succession the yield decreases and most farmers use some form of crop

rotation to prevent this decline. Many depend upon it almost entirely for the maintenance of fertility.

No exact rotation can be recommended for any particular soil or for any section of the country, because each man must arrange the rotation which will best suit his own conditions. It will depend upon the previous treatment of his soil, the use he wishes to make of his crops, the price of various crops, and other conditions. There are some general principles, however, which may be safely followed.

Any good system of rotation for Cooper County will include a legume crop such as clover, cowpeas, or, in some cases, alfalfa. These crops take up nitrogen from the air and through the decay of their roots give it up to the crop of corn or wheat which follows them. The tops of these plants, however, also contain large amounts of nitrogen and add organic matter which is needed to improve the texture of these soils, so that the greatest benefit is derived from plowing under these crops or by feeding them on the land.

The most common rotation used in Cooper County is that of wheat, clover, and corn. Corn is cut as early in the fall as possible and wheat sown. Early in the spring clover seed is sown in the wheat and after the grain has been cut, if the season is favorable, often makes a fair crop of hay, especially on the better lands. If not cut it is used for pasture. The next season the clover is cut for hay, the second crop often being thrashed for seed. In the fall the clover ground is plowed and the next spring put into corn. Usually two and sometimes three or more crops of corn follow clover.

This rotation has the advantage of a legume crop and also of being adjustable. If the soil is somewhat run down the rotation should be made for three years, growing corn but one year. If the soil is in good condition, however, and well supplied with organic matter the clover may be followed by two corn crops, but under ordinary conditions not more than two crops in succession should be attempted.

The value of this rotation in building up the soil can be greatly increased by plowing under the second crop of clover instead of cutting or pasturing it and also by sowing cowpeas in the corn after the last plowing, provided it can be arranged to graze them with sheep before time for sowing wheat. Cowpeas may also be introduced as the legume crop instead of clover and are especially useful in the prairie sections, where clover is damaged by heaving.

Cowpeas may sometimes follow wheat the same season and be followed by corn, thus making a two-year rotation, although this is not widely applicable. It is confined to small areas, as it is impossible to get the peas in on large areas as a rule. Where alfalfa is used it is allowed to stand three years or more before being plowed up.

Besides a change of crops, the addition of stable or of green manuring crops is necessary if this land is to be maintained in productiveness. Any green crop which is plowed under and rots is of value to the soil, through the addition of plant food and the effects of organic matter upon the physical condition of the soil. When a legume crop is plowed under it is especially valuable through the addition of large amounts of nitrogen which it has derived from the air. It would be possible, of course, to add organic matter in such quantities or under such conditions that it would prove injurious, as when a heavy weed crop is plowed under late in the spring and followed by dry weather or when such excessive amounts of straw or coarse manure are used that they cause the soil to dry out too readily. But the soils of Cooper County as a whole, with the exception of a few small areas in the bottoms, need nitrogen and organic matter and will respond promptly to the proper use of green manures. Stable or yard manure should be scattered thinly and uniformly over the fields by means of a spreader and have a regular place in the crop rotation usually preceding the corn.

The serious results following long and constant use of commercial fertilizers in the older States seem to justify a word of warning here where their use has just begun. The advantage in using commercial fertilizers lies in the effect upon the immediate crops and when found profitable the tendency is strong to rely on their use from year to year to the neglect of the rotation of crops and the addition of humus. The soil is stimulated to greater effort, but the stimulant soon becomes necessary, the humus is burned out, the soil bakes when dry, runs together when wet, is difficult to handle, and eventually is "worn out." The better farming aims to produce the largest crops and bring the largest returns while at the same time maintaining the fertility of the soil or increasing it. Such farming depends upon crop rotation, the saving and application of animal manures, the use of green manures whenever possible, and a resort to commercial fertilizers only for a temporary special purpose or as an adjunct to the other means of increasing the productivity of the soil.

Grain stubble should be plowed as soon after the grain is cut as possible. Every day the ground which has been plowed that day should be gone over with a heavy harrow, which will level the surface and check evaporation. As soon as the plowing is completed the ground should be thoroughly disked and cross disked to pack the subsoil and then harrowed to make a surface mulch. If this mulch is spoiled by a rain it must be restored by another harrowing as soon as possible.

By cultivation before plowing the soil can also be kept in good moisture condition. All farmers know that at some time during the spring the soil plows much better than at other times. It is just right because it is in the proper moisture condition. The same is usually true of stubble ground when the crop is first removed. When the soil is in this condition it can be kept so for many weeks by any form of cultivation which will cover the surface with a mulch. A good disking followed by a harrow is perhaps the best. By this means the work of plowing is made much easier, the period of plowing lengthened, and the work made much more satisfactory. This plan has the additional advantage of cultivating that portion of the soil which is turned under and forms the seed bed. It also saves much labor after the ground is plowed. It is true that in the spring some labor may be lost through the repacking of the soil by rain, but on the whole this process will pay.

By conserving the moisture wasted during the early part of the growing season a corn crop can be made much more certain. With the rainfall of this region there would rarely be injury from drought if the moisture could be conserved and used as needed, and this can be done to a considerable extent by suitable cultivation.

After the completion of the field work of the soil survey in Cooper County it was decided to collect additional data, and circular letters were sent to a number of prominent farmers in different parts of the county. These letters asked for estimated average yields for the past 10 years, whether the yields are believed to be increasing or decreasing, the cause of increase or decrease, the varieties of grain used, the rotation followed, the kind of fertilizers used, and the smallest farm on which the writer believed a farmer could make a good living by general farming.

The following table, compiled from the answers received, although not conclusive on account of the small number of farms represented, gives some interesting data, which are believed to be approximately correct for a large part of the county.

Since two or more soil types are often represented on the same farm, the estimated yield can not be considered as being confined strictly to the soil type given in the first column, which is the principal type represented, but not the only one.

The location given in the first column is also only the approximate location, usually being the nearest post office.

Average yield for corn and wheat for the past 10 years, changes in yield, cause of increase or decrease, varieties used, rotation followed, kind of fertilizers, and smallest farm required to support a man and family in general farming.

Kind of soil and approximate location.	Corn.			
	Average yield per acre est.—10 years.	Yield—increase or decrease.	Cause of increase or decrease.	Varieties used.
	Bushels.			
1. Loess, south of Boonville.	50	Increase	Pasturing and manure.	Reids Yellow Dent.
2. Limestone, Bunceton.	35	Increase	Rotation, clover cultivation.	Yellow on upland, White on bottom.
3. Eroded prairie, Soleville.	30	Increase	Clover and stock feeding.	Yellow Dent, Cherokee White.
4. Prairie, Lone Elm.	40–45	Increase	Cultivation	Reids Yellow Dent, Boon County White.
6. Prairie, Lone Elm.	42	Increase	Clover and cultivation.	Cartners.
7. Loess, Boonville	50	Stationary		Yellow Dent, Cartners, Bloody Butcher, Johnson County White.
8. Loess, Boonville	50	Increase	Improved soil, better cultivation.	Yellow Cartners.
10. Bottom, Bellair	50	Decrease	Lack of rotation, no legumes.	Reids Yellow Dent.
11. Eroded prairie, Clarks Fork.	30	Decrease	Erosion and poor farming.	No particular variety.
13. Prairie, Pilot Grove.	45	Stationary	Varies with seasons	Yellow Dent.
14. Loess, Overton	45	Increase	By use of clover	Cartners.
15. Prairie, Bunceton	40	Increase	Rotation, cultivation.	Cartners, Reids Yellow Dent, Howard County White.
16. Eroded prairie, Prairie Home.	30	Increase	Manure, clover	Yellow dent.
17. Prairie, New Palestine.	40	Increase	Rotation, cultivation	Cartners.
18. Limestone, Pilot Grove.	35	Decrease	Renting land, poor tillage.	Cartners.
19. Loess and limestone, Clarks Fork.	40	Increase	More stock, more grass, manure.	Reids Yellow Dent.
20. Bottom, Billingsville.	40	Increase	Manure, drainage	Cartners.

Average yield for corn and wheat for the past 10 years, changes in yield, cause of increase or decrease, varieties used, rotation followed, kind of fertilizers, and smallest farm required to support a man and family in general farming—Continued.

Kind of soil and approximate location.	Wheat.			
	Average yield per acre est.—10 years.	Yield—increase or decrease.	Cause of increase or decrease.	Varieties used.
	Bushels.			
1. Loess, south of Boonville.	.....	.....	.....	
2. Limestone, Bunceton.	16	Stationary.....	.....	Fultz.
3. Eroded prairie, Soleville.	9	Increase.....	Clover and manure....	Redchaff.
4. Prairie, Lone Elm..	16	Increase.....	Early plowing and packing.	Fultz, Redchaff, Blue Stem.
6. Prairie, Lone Elm..	15	Stationary.....	.....	Fultz, Redchaff.
7. Loess, Boonville....	20	Decrease.....	Bad seasons.....	Fultz.
8. Loess, Boonville....	20	Increase.....	Improved soil and cultivation.	Harvest King.
10. Bottom, Bellair	12	.....	.....	Fulso-Medeter.
11. Eroded prairie, Clarks Fork.	15	Decrease.....	Failure to use fertilizer.	Fultz.
13. Prairie, Pilot Grove.	14	Decrease.....	Seasons and fly.....	Fultz.
14. Loess, Overton.....	18	Decrease.....	Poor seed.....	Fultz.
15. Prairie, Bunceton...	18	Increase.....	Better preparation of soil.	Fultz Bearded.
16. Eroded prairie, Prairie Home.	15	Decrease.....	Failure to get stand of clover.	Redchaff.
17. Prairie, New Palestine.	13	Decrease.....	Poor cultivation.....	Fulso-Medeter.
18. Limestone, Pilot Grove.	22	Decrease.....	Seasons.....	Fultz.
19. Loess and limestone, Clarks Fork.	19	Increase.....	More stock, better farming.	Redchaff, Fultz.
20. Bottom, Billingsville.	15	Increase.....	Manure, clover.....	Redchaff.

Average yield for corn and wheat for the past 10 years, changes in yield, cause of increase or decrease, varieties used, rotation followed, kind of fertilizers, and smallest farm required to support a man and family in general farming—Continued.

Kind of soil and approximate location.	Rotation used.	Fertilizers used.	Smallest farm on which family can make good living.
			Acres.
1. Loess, south of Boonville.	Corn, oats, clover, pasture	Manure	40 or 50
2. Limestone, Buncetон.	Corn, oats, wheat, clover	Clover, some commercial	40 up
3. Eroded prairie, Soleville.	Corn 2 or 3 years, oats, wheat, clover.	Clover plowed under manure	80
4. Prairie, Lone Elm	Corn, oats, wheat, clover	Manure, clover	80
6. Prairie, Lone Elm	Corn 2 years, wheat 2 years, clover 2 years.	Manure, clover	.....
7. Loess, Boonville	Corn, wheat, or oats 2 years, clover.	Pasture	80
8. Loess, Boonville	Corn, wheat, clover, and timothy.	Clover, manure	40
10. Bottom, Bellair	Corn, small grain, clover	Cowpeas, clover, manure	80
11. Eroded prairie, Clarks Fork.	Corn, wheat, clover	Clover, manure	80
13. Prairie, Pilot Grove.	Corn 1 or 2 years, wheat 1 or 2 years, clover 2 years.	Clover, manure	60
14. Loess, Overton	Corn, oats or wheat, clover	Commercial fertilizer, manure	30
15. Prairie, Buncetон	Depends on conditions	Manure	60
16. Eroded prairie, Prairie Home.	Corn, clover	Manure	40
17. Prairie, New Palestine.	Corn, wheat 2 years, grass	Manure, pasture	.....
18. Limestone, Pilot Grove.	Corn, wheat, clover	Clover, pasture	80–100
19. Loess and limestone, Clarks Fork.	Corn 2 years, wheat or oats, grass 2 years.	Manure, clover, pasture	160
20. Bottom, Billingsville.	Corn 2 years, wheat, clover 2 years.	Manure, clover	.....

It will be noted from this table that a large majority of the farmers believe the yield of corn to be increasing, due to pasturing and feeding stock, the use of clover and manure, and to better cultivation and rotation. The principal varieties are Reids Yellow Dent and Cartners, with different varieties of white usually used on the bottom lands.

The general impression seems to prevail that the yield of wheat is either decreasing or remaining about the same, due to a number of causes. Some believe it is increasing for the same reasons that corn is increasing. The principal varieties are Fultz and Redchaff, Fultz giving better results on the bottom lands and Redchaff on the hills.

The common rotation is corn one or two years, wheat or oats, clover usually two years. The importance attached to the use of clover and

manure is rather striking. The opinion seems to prevail that between 60 and 30 acres is the smallest size farm on which a man can make a comfortable living for himself and family in Cooper County by general farming.

SOILS.

The soils of Cooper County group themselves naturally into four principal divisions, the level upland soils, the loessial soils, the residual soils, and the alluvial or bottom land soils.

The origin of the level upland soils is open to some doubt. The soil as it exists at the present time is very much like the upland soils of Northeastern Missouri, which are known to have been derived from glacial material laid down either by water or wind. The latter are underlain by glacial deposits, while the level upland soils of Cooper County have no glacial material beneath them. They lie on the residuary silts and clays derived from limestones or on the limestone itself. Typical glacial deposits, like those underlying the northeastern Missouri soil, are not known to occur under the level upland soils of central and southern Cooper County.

The soils in Cooper County are also very much like certain smoothland soils in Pettis, Henry, Bates, Vernon, and other counties in southwestern Missouri. They extend across the State line into southeastern Kansas. These soils are undoubtedly derived from Coal Measure shales and clays. The Cooper County soil is a somewhat better soil than the similar soil occurring in these counties, but its physical character, the thickness, the nature of the subsoil, and relation to the underlying rock are essentially the same. Its greater productivity is probably due to its better drainage and its higher percentage of humus.

Because of the absence of underlying glacial material and of the close similarity between this soil in Cooper County and those in the counties named above, the Cooper County soils have been correlated with the latter rather than with the soils of northeastern Missouri, and are considered to have been derived from clays and shales of Coal Measure age.

The origin of the loess is not clearly understood, but it is supposed to be due, in part at least, to the removal and deposition of materials from previously glaciated areas by the wind. The present soils of this group are the result of weathering of these deposits. The residual soils have come from the weathering in place of various beds of rock, principally limestone, occupying the hill slopes between the upland prairies and the valley floors.

The alluvial soils are of recent origin, and have been deposited in the flood plains of the streams by which they have been carried to their present position.

The loess soils stretch in a rather narrow belt along the northern side of the county. On the extreme eastern boundary the loess disappears as a typical deposit. A narrow wedge of it ends 1 mile west of the county line and north of the Petite Saline. Thence westward the belt widens, but it does not attain a greater width than 2½ miles, except in one or two places.

The loess soils are usually recognized by the somewhat rounded topography of the country over which they are spread; by the light yellowish-brown color of the soil; by its smooth satiny texture; by the high perpendicular bluffs, which shut in the older roads; by the absence of rocks of any kind, except occasionally near the bottom of the deepest ditches; by the uniform texture of soil and subsoil; and usually by the strong, healthy appearance of the growing crops.

In elevation the loess soils range from a little over 600 feet above sea level on the lower slopes to a little over 750 feet along the crest of the ridge which extends almost continuously from near Wooldridge on the east entirely across the county. The surface, therefore, has a range in elevation of only about 150 feet, yet, except for a few flat areas on the higher portions of the western end of this ridge, it has a well-rounded billowy topography, which is in marked contrast to the sharper cut topography of the residual soils farther south.

Over a large proportion of the area covered by the loess soils the same material extends entirely over the surface, covering crests, slopes, and valleys. The formation is deepest, however, near the Missouri River and thins out toward the south, its southern boundary being a very indefinite line. It also seems to be somewhat thicker on the crest of the ridges and at the foot of the slopes than on the slopes, and as the southern edge of the area of deposition is approached it appears only upon the ridges.

Although the greater portion of the country occupied by the loess soils is quite undulating, limited areas in the northwestern part of the county are more nearly level and are darker in color.

The loess soils in this area have been divided into two classes, the undulating lighter-colored soil, called the Knox silt loam, and the more nearly level darker colored soil called the Marshall silt loam.

A large part of the uplands south of the loess soils is called prairie and is distinguished by the absence of natural timber growth. The soils here are characterized by an almost level surface and by a black silty surface material which grades into a gray silt, and is underlain by a layer of stiff resistant clay several inches in thickness, which in turn is underlain by a mottled yellow and gray silty clay. From the very close resemblance between the subsoil of the prairie, as seen in the exposures on eroded slopes, and the subsoil exposed near the edge of the loess sheet, it would seem that these prairie soils were partly covered along the northern side of the county by loess.

In many places the transition from the prairie soils to the residual soils is quite abrupt, only a few steps intervening between the black surface soil with heavy clay subsoil and the reddish-yellow chert-filled residual soil; but throughout the greater part of the area the prairie soils proper are bordered by a soil differing from the prairie soil in being gray or yellowish-brown at the surface instead of black, in occupying the slopes of small streams which extend back into the prairie in places covering the narrow ridges between the small streams, and in having, in most cases, no well-defined clay layer in the subsoil. This soil may be considered a modified prairie soil, the modification in some places being due to the erosion of the surface of the prairie, in others to the gradual movement or creep of the soil particles down the slopes, and in others to a thorough leaching of the soil along the ridge crests. This region was formerly timbered to a considerable extent.

The level upland soils, then, may be divided into the level black prairie soil, called the Oswego silt loam, and the modified glacial soil, lighter in color and usually without the heavy layer in the subsoil, called the Boone silt loam.

The foundation rocks on which the Cooper County soils lie, in some cases having been derived from the rocks and in others merely brought in from the outside and laid on them, are of two kinds, limestones and detrital rocks. There are two kinds of limestone, one being somewhat earthy, subcrystalline rock carrying a moderate to small amount of flint, the other a highly crystalline rather pure lime carbonate rock with a rather large proportion of flint in it. The former is of early Silurian age; the latter of early Carboniferous.

The detrital rocks are sandstones, sandy shales, and clays. Those found in Cooper County now are merely a remnant. At one time they extended over the whole county. They are of late Carboniferous age.

The limestone first described occurs in the southeastern part of the county. The other one underlies the rest of the county, but it is covered by the sandstones, shales, and clays. The latter rocks occur only in a small belt that extends from west to east across part of the northern portion of the county, from the neighborhood of Lamine to that of Clarks Fork. This belt lies along the belt of low country mentioned in the discussion of topography. The foundation rock of the county therefore is chiefly limestone. Even where it does not occur immediately under the layer of loose material forming the soil it lies only a short distance beneath.

In the rougher portions of the county south of the Blackwater-Petite Saline line there is no possible question about the origin of the soil. It is a residual limestone soil, partaking of the nature of the rocks that underlie it. The soils in the sandstone-shale-clay belt

likewise are residual soils, derived from these same sandstones, shales, and clays and partaking of their nature. Along the river bluffs and extending southward for a few miles the foundation rock, whether it be limestone, as it is in most places, or sandstone-shale-clay rock, as it is in a few cases, is covered by the loess, a brown silt deposit. From this material has been made the soils of the river hill belt.

The soils of the uplands south of the Blackwater-Petite Saline belt are derived from a silt and clay soil material that lies on limestone but has not been derived from it.

There are at least two possible sources of this material: (1) It may be a disintegrated remnant of shales and clays that originally overlaid this area. The shales and clays have been broken up by weathering into silts and clays, but the material has not been removed by erosion on account of the protection afforded by the solid limestone on which it lies. (2) It may be a layer of overwash or outwash glacial material that was spread out over this region during glacial times by streams flowing out from the glacier. At the present time the former seems to be the most probable origin of this material. The general soil belts or areas of the county therefore are (1) residual limestone soils, (2) residual sandstone-shale-clay soils, (3) loess soils, (4) soils of doubtful origin but probably residual soils from shales, clays, and fine-grained sandstones, and (5) alluvial soils. The accompanying map shows the distribution of these soil areas. The differentiation in the field of the residual soils of the sandstone-shale-clay belt from the loess soils to the north of it has proved to be a difficult matter. They are both silty soils and both brown in color. Where the rock does not underlie the soil it is very difficult to locate the boundary. The criterion used was the percentage of clay in the subsoil. The loess soil has a low clay percentage. When the subsoil had enough clay to make it sticky, it was not considered as of loessial origin. The character of the native vegetation, especially the trees, was used as a supplementary criterion in mapping this difference.

The alluvial soils are made up from material eroded from all other soils of the area, carried by water in suspension and redeposited. They vary greatly in character, depending upon the source from which derived, the methods of deposition, and the processes they have undergone since they have been laid down.

The alluvial soils in the southern part of the county contain much material which has been carried down from the eroded edges of the prairie and the gray silt ridges mixed with material from the residual soils. Those found along the streams which drain the loess are derived almost entirely from that formation and resemble it closely, while those deposited along the Missouri River have come from several different sources, are more complex, and differ essentially in composition from the other alluvial soils of the county.

Closely related to the alluvial soils are the soils found in the valleys of small streams and along the base of long slopes, where the soils, although they have not been carried in suspension, have reached their present position through the gradual work of surface water, which has removed the particles from the uplands and the slopes to the lowlands. This drift or creep often results in almost flat areas of dark-colored soil, more or less similar to the true alluvial types, and where these areas are of sufficient extent they have been grouped with the alluvial soils.

The alluvial soils have been divided into two groups. Those derived from the loess, glacial, and residual soils and found along the streams of the county have been mapped as Wabash soils, and those found along the Missouri River have been classified as Sarpy soils.

The following table gives the relative and actual extent of each of the several soil types found in the survey. The distribution of the several soils is shown by means of colors in the accompanying map:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Boone silt loam	78,208	21.8	Sarpy silt loam	5,120	1.4
Oswego silt loam	70,848	19.7	Marshall silt loam	3,968	1.1
Clarksville silt loam	65,024	18.1	Wabash clay	2,176	.6
Wabash silt loam	57,600	16.0	Sarpy silty clay	1,792	.5
Knox silt loam	25,600	7.1	Sarpy fine sandy loam	960	.3
Baxter silt loam	25,088	6.9			
Bates silt loam	13,376	3.9	Total	359,040	
Clarksville stony loam	9,280	2.6			

KNOX SILT LOAM.

The Knox silt loam is a light-buff or very light yellowish-brown silt loam, smooth and satiny in texture. At a depth of about 16 inches this material passes very gradually into a heavier silt loam, in which the proportion of very fine sand found in the surface soil is very much reduced while the clay content is slightly increased. The subsoil is also more yellow and sometimes shows a reddish tinge. It extends to a depth of several feet. In many places at a depth of 4 or 5 feet there occurs a horizontal layer of material discolored a reddish brown by iron oxide. This layer usually contains numerous small iron concretions and in places small pipes of the same material. Below this depth the soil grades into a more or less mottled gray and yellowish silty clay. Where exposed to the direct action of running water or to travel, as in the public roads, the loess from which the type is derived wears away very rapidly and yet the soil seems to be of such a texture, the soil grains of such a shape, or else the material is so held together

by a very slight cementation that instead of creeping and moving to form slopes it stands in perpendicular banks. As it weathers it also develops a peculiar system of perpendicular cracks which, with horizontal cracks at greater intervals, gives it a peculiar columnar structure somewhat resembling basaltic columns.

This soil was formerly timbered and supported a heavy growth of white, bur, and laurel oak, black and white walnut, hickory, elm, hackberry, wild cherry, ash, honey locust, pawpaw, sassafras, wild plum, and hazel, but on account of its value for agricultural purposes very few areas, and these of small extent, remain uncleared. When the land is first cleared, owing to the very large amount of leaf mold and humus at the surface, this portion of the soil is quite black, but after weathering and leaching for a few years, it becomes much lighter in color, and in many places the surface when well leached and dry is a light-gray differing but little in color or texture from the gray silt ridges of the Boone silt loam. As noted already, the Knox silt loam occupies the larger part of the survey between the main east and west lines of the larger streams of the county and the Missouri River, the area approximating one-fifth of that of the entire county.

As a whole the Knox silt loam is the best soil of the area. It is a deep, well-drained soil, yet holds moisture well. This is noticeable during periods of dry weather when the crops on it are much better able to withstand the drought than those on some of the other soils of the area. In the fall, too, the forest trees on it remain green much longer than on the more shallow residual soils. This soil is warm, friable, easily cultivated, and productive. The average yield of corn on fields in the best condition is about 48 bushels and of wheat 19 bushels per acre.

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

Mechanical analyses of Knox silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
22357, 22359.....	Soil.....	0.0	0.1	0.1	0.4	13.7	72.4	13.2
22358, 22360.....	Subsoil.....	.0	.0	.2	.3	4.4	70.1	24.9

MARSHALL SILT LOAM.

The Marshall silt loam, like the Knox silt loam, is of loessial origin, but it differs from the latter in color, topography, and character of the subsoil. On the other hand, it differs from the Oswego silt loam, which it resembles at the surface, in having a deeper surface soil

and in lacking in places the stiff resistant clay layer found in the subsoil of the latter.

The surface soil of the Marshall silt loam is a very dark gray to black, smooth, friable silt loam, which extends to a depth of about 20 inches, the lower part of the section usually becoming somewhat lighter in color. The subsoil is a brown mottled silty clay grading at a depth of 24 to 30 inches into a yellowish and grayish mottled silty clay, somewhat lighter in texture. In the more level areas a heavy, almost impervious layer of brown silty clay, 6 to 10 inches in thickness, forms the upper portion of the subsoil, but in the more rolling areas this heavy layer is almost or entirely wanting.

The Marshall silt loam is found in only a few small areas in Cooper County, the largest of these occupying the more level land in the extreme northwestern portion of the county. A few small bodies also occur southwest of the town of Blackwater, north of Lone Elm, and in the vicinity of Clarks Fork.

This soil is well supplied with humus and is a friable, easily cultivated productive soil. Corn yields from 40 to 50 bushels and wheat from 13 to 18 bushels per acre.

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

Mechanical analyses of Marshall silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
22353, 22355.....	Soil.....	0.0	0.5	0.4	0.4	2.0	74.4	22.4
22354, 22356.....	Subsoil.....	.0	.9	.6	.6	3.7	66.9	27.2

OSWEGO SILT LOAM.

To a depth of 10 inches the Oswego silt loam is a smooth, friable, black or very dark brown silt loam, often containing in the first few inches an appreciable quantity of very fine sand. Below 10 inches the dark-colored surface soil grades into a lighter colored gray silt. The soil also becomes slightly heavier in texture with increased depth, and at about 16 inches rests on a very heavy, tenacious, brown silty clay, which often contains numerous small iron concretions. The line of contact between the soil and this heavy subsoil is very sharp, but the thickness and tenacity of this heavy layer varies considerably in different parts of the area, being thicker and more resistant on the more level and poorly drained portions. At a depth of about 30 to 34 inches this heavy subsoil grades into a yellowish and gray mottled silty clay subsoil lighter in texture than the soil above and resembling closely the subsoil found in places under the loess soils.

In the subsoil, usually in the lower portion of the heavy layer, small irregular lime concretions are found, the quantity in places being relatively large.

The Oswego silt loam is one of the extensive soil types in the area and occupies the higher and more nearly level portions of the area covered by the upland glacial soils. The largest body of it occurs east of Bunceton and south of Lone Elm, but other large bodies occur in the vicinity of Prairie Home, between Moniteau Creek and Stephens Branch on the east and Petite Saline on the west, and between Petite Saline and the Lamine. Small areas also occur in the southeastern and in the southwestern parts of the county.

Although the soils of these areas resemble each other to a sufficient extent to be classified under the same name, there is considerable variation in appearance and in crop value, the soils west of a north and south line through Bunceton and especially those southwest of Vermont being dark-brown instead of black in color, having a somewhat shallower and more resistant subsoil, and as a whole being less able to withstand droughts. They are also not so well suited for deep rooted crops. There are also variations between the soils of areas which drain toward Moniteau Creek and those farther north which drain into the Petite Saline, the latter in most places being slightly deeper, darker colored, and resembling more closely the Marshall silt loam.

The Oswego silt loam is a corn, timothy, and pasture soil, although wheat and oats are grown on it to a considerable extent. Some farmers are using portions of it where the subsoil is not too heavy quite successfully for clover. On the average the type yields 42 bushels of corn and 15 bushels of wheat per acre.

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

Mechanical analyses of Oswego silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
20987, 20989.....	Soil.....	0.1	1.6	0.7	0.8	0.6	74.3	22.0
20988, 20990.....	Subsoil.....	.0	1.1	.5	.8	1.6	61.3	34.8

BOONE SILT LOAM.

The Boone silt loam has not only the widest distribution, but also the greatest range in variation and crop value of any soil in the area. Typically it consists of yellowish-brown or grayish-brown silt loam of fairly uniform texture, with a depth of about 15 inches, at which

depth it becomes slightly heavier in texture, grading into the same mottled yellow and gray silty clay subsoil found in the Oswego silt loam. This subsoil persists to a depth of 3 feet or more, or where thin rests upon the underlying stony material derived from the underlying rocks. This material has a granular structure much like that of the residual limestone soils, and where it occurs typically no heavy layer occurs between the soil and subsoil.

The Boone silt loam borders the Oswego silt loam, or prairie soils, on all sides, and may be considered a transitional type between the Oswego silt loam and the lower lying residual soils. It is also always more or less mixed with both, the prairie soils being washed down and mixed with it and the underlying residual soils mixed with it through the movement of the soil particles down the slope, so that its boundaries are in places very indefinite. In origin it is like the Oswego silt loam, and is in reality a modified form of that soil, resulting from the removal of material from the surface. In areas where erosion has taken place the yellowish brown less productive soil is exposed at the surface. Boone silt loam where the black prairie soil formerly existed can be noted around the source and along the slopes of many small streams which head well back into the prairie.

At the foot of long slopes and especially along the heads of small streams the wash may accumulate, forming a deep, often dark-colored soil. Where such areas are of sufficient extent they have been mapped as alluvial soils, but where too small to be indicated on the soil map they have been included with the Boone silt loam.

Another phase of this soil is to be found along the tops of long, narrow ridges which extend from the prairie out between the upper courses of small streams. The soil of these ridges ranges in color from an ashy gray to cream color and in texture from that of the loess to a loose flourlike silt, probably not loess, the loess areas being found in the northern part of the area covered by the type, and the whiter ridges principally in the southern part of the county. The light soil of these ridges seems to be the result of thorough leaching, in which not only the color but also much of the fertility of the soil has been removed. In many places along the tops of the ridges a heavy brown clay layer has been developed at a depth of from 14 to 18 inches, the transition from the light silt to this layer being very abrupt. Below the brown clay occurs the mottled silty clay, found under the remainder of this soil. These ridges in the northern part of the area undoubtedly in many places bear a thin capping of loess and approach the loess in crop value, but those farther south are less productive.

A large part of the Boone silt loam was originally timbered by oak, post oak and bur oak being the principal growth on the ridges, which are locally called "post oak ridges" and have the heavy layer in the subsoil.

The Boone silt loam as a whole is not so productive a soil as the prairie soil on the one side nor the limestone soils on the other. It has been one of the worst used soils in the area, is deficient in organic matter, and does not hold moisture well, yet it is a soil which can readily be built up and made to yield profitable crops.

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

Mechanical analyses of Boone silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fne sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
20995, 22351.....	Soil.....	0.4	1.4	0.7	1.0	5.3	71.8	19.5
20996, 22352.....	Subsoil.....	.1	.9	.8	1.2	3.2	67.5	26.1

BATES SILT LOAM.

The Bates silt loam is a dark-gray to grayish-brown silt loam with a yellowish tinge which becomes quite noticeable where the soil is eroded. At a depth of 6 to 10 inches this graduates into a yellowish-gray to yellowish-brown silt loam. The clay percentage increases downward until at 30 inches it becomes plastic and in places quite sticky. The lower 15 to 20 inches is usually mottled yellow and gray. Bands of brown to reddish-brown silt, in places faintly cemented, in others having the iron somewhat concentrated in nodules, occur rather abundantly from 24 inches downward. They lie horizontal. Layers of a light ashy gray silt and silty clay occur also, showing an ashy gray color in the freshly plowed fields when it has been exposed.

This soil differs from the Knox silt loam mainly in its more yellow color and its higher percentage of clay in the subsoil. Its color is also much less uniform than is that of the Knox. On plowed hillside fields its color varies with the erosion and the color of the particular layer outcropping, while that of the Knox is uniform.

The timber growth is like that of the Knox, but contains a higher percentage of oaks, especially laurel, pin and post oak, and a lower percentage of walnut and elm.

The Bates silt loam is derived from Coal Measure shales, clays, and argillaceous sandstones mixed more or less with the material of the Knox silt loam. It occurs in an east-west belt across the northern part of the county. Where the surface is flat the soil is essentially the same as the Oswego silt loam. It becomes the Boone silt loam only within the areas where the surface has been eroded. The belt of its occurrence lies along an east-west pre-Coal Measure valley which was filled with Coal Measure material during Coal Measure time. It lies deeper than the same rocks on the uplands to the north and south of it. They have disappeared from the latter areas, but still exist in this belt.

CLARKSVILLE SILT LOAM.

The soil of the Clarksville silt loam is a reddish or yellowish-brown silt loam having a somewhat granular structure, by which it can often be distinguished from the other silt loams of the area. Typically it extends to a depth of about 15 inches, where it grades into a silty clay usually brighter, often a brick red, in color. This subsoil may persist to a depth of 3 feet or more, but often at a less depth rests upon the underlying bed of chert or limestone, that part of the subsoil immediately above the rocks usually being a very stiff red or yellow clay.

This soil is residual in origin, having been derived from the disintegration in place of beds of fossiliferous limestone, the principal formations being the Burlington and Choteau. These, especially the Burlington, contain much chert, the disintegration of which takes place much less rapidly than does that of the purer limestone, so that the soil is often quite shallow, and fragments of chert are mingled with the soil and scattered over its surface. Where the soil is very shallow and the chert fragments are so thick as to interfere seriously with cultivation, the areas, if of sufficient size to be shown on the soil map, have been mapped as the Clarksville stony loam.

The Clarksville silt loam occurs along the lower slopes of all streams in the area, except those in the northern part of the area which are covered by loess, the tributaries of Moniteau Creek and some of the tributaries of the upper Lamine. Where the crests of the ridges and hilltops carry no capping of glacial or loessial material the entire surface is covered by this soil.

Originally the Clarksville silt loam was heavily timbered with black walnut, laurel oak, elm, hickory, and sassafras, and many splendid groves of black walnut are found on it at present in different parts of the area. Where of good depth, comparatively free from chert, and well handled, it is probably the best wheat soil of the area. Corn yields range from 35 to 40 bushels and wheat yields from 16 to 22 bushels per acre.

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

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.*	*Per cent.*
20991, 22349.....	Soil.....	0.0	0.5	0.3	0.8	3.4	70.1	24.9
20992, 22350.....	Subsoil.....	.2	.5	.3	1.0	5.3	63.2	29.4

CLARKSVILLE STONY LOAM.

The Clarksville stony loam is agriculturally an unimportant type and consists of those areas in the Clarksville silt loam in which the percentage of rock at or near the surface is so large that they are of little or no value for farming. Some of the less stony portions might be cleared of stones and used for orchard and pasture, but in many cases the surface of the ground is almost or entirely covered with fragments of chert. In other places there is a surface covering of soil, but this is so thin that it can scarcely be cultivated. Areas in which limestone outcrops along the bluffs and hill slopes have been included with this soil as well as some of the stony areas found along Moniteau Creek and surrounded by Baxter silt loam.

The greater portion of the Clarksville stony loam is still timbered, usually with post and bur oak, and clumps of these trees in areas of Clarksville silt loam usually mark the stony areas. Many areas of this soil on account of their small size have not been separated from the silt loam.

No samples for mechanical analyses were collected, on account of the high percentage of chert fragments.

BAXTER SILT LOAM.

The surface soil of the Baxter silt loam consists of a light yellowish brown silt loam which, at a depth of about 16 inches, grades into a silty granular clay. The subsoil becomes heavier in texture and redder in color to a depth of about 2 feet, where it is mottled in appearance, this mottling extending to a depth of 3 feet or more.

The Baxter silt loam, like the Clarksville silt loam, is residual in origin. It is derived from the disintegration of the less fossiliferous and, in this area, more cherty Magnesian limestone which outcrops in the southeastern and also in the southwestern part of the county. It differs but little in color or texture from the Clarksville silt loam, but on the whole is less productive. The timber growth consists principally of white, bur, and post oak, the walnut, elm, and other trees of the Clarksville soils being almost entirely wanting. Many of the ridges also have the whitish appearance of the post-oak ridges of the Boone silt loam.

This soil in places is 3 feet or more in depth, but is often underlain at a less depth by chert fragments or by limestone. Chert and fragments of the soft white "cotton rock" are often scattered over the surface and through the soil, making it unfit for cultivation.

No samples for analyses were obtained.

WABASH SILT LOAM.

The Wabash silt loam is an alluvial soil composed of material eroded from the other soils of the area, worked over by the streams, and redeposited along their flood plains. In the northern part of the county, along the lower course of the Petite Saline and the small streams which flow into the Missouri, this soil has been derived very largely from the loess; but in other parts of the area it has come from areas occupied by the residual soils and the upland soils of glacial origin, the light-colored silt from the gray ridges being in many places quite noticeable.

Although varying considerably in color, texture, and structure the Wabash silt loam, as occurring in this area, may be described as a dark-gray or, when moist, a black, smooth-textured, friable, light silt loam, which becomes lighter in color at a depth of about 12 inches, but shows no change in texture to a depth of 2 feet or more. At this depth the material usually becomes darker and heavier, retaining these characteristics to a depth of several feet. In places, however, the subsoil is underlain by gravel, unconsolidated residual material, or the solid rock. In many places a gray, flourlike silt covers the surface of small areas, and in others the gray layer below the surface soil is wanting, the dark, rather heavy silt loam extending from the surface to the depth of 3 feet or more. In still other places the surface soil is found to contain a relatively high content of very fine sand. Where the light-colored phase occurs it is, like the gray silt ridges from which it has been eroded, somewhat less productive than the darker soils. On the other hand, where the very dark, rather heavy silt loam extends through the entire soil section the type is often poorly drained and somewhat refractory under cultivation. Much of the Wabash silt loam is subject to annual or occasional overflow, and while this adds to the richness of the soil through the deposition of silt, especially when the material comes from the loess or the residual soils, these periods of high water usually occur at times when they do considerable damage to crops.

Where second bottoms occur they are in most cases above the reach of flood water. The soils are also comparatively uniform in texture, well drained, and among the most productive of the area. Along the steep slope which usually separates the lower bottom from these second bottoms there is often exposed a narrow strip of red residual soil.

As a whole, the Wabash silt loam, although lacking uniformity, is among the best soils of the county. It is especially well adapted to alfalfa, owing in part to the position of ground water, which is near enough the surface for this deep-rooted plant to reach. Corn yields

an average of 45 bushels and wheat between 14 and 20 bushels per acre.

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

Mechanical analyses of Wabash silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
20993, 22367.....	Soil.....	0.0	0.2	0.2	1.3	5.5	72.1	20.6
20994, 22368.....	Subsoil.....	.0	.5	.3	1.8	7.4	71.1	18.8

WABASH CLAY.

The Wabash clay is an unimportant type in this area, only a few small bodies of it having been mapped, although many others too small to be shown on the soil map occur in the lower poorly drained portions of the Wabash silt loam. It is a heavy, sticky black clay, which dries and cracks at the surface, the soil breaking into small, irregular cubelike fragments. At a depth of about 16 inches this black soil grades into a stiff, waxy clay, somewhat lighter in color, which extends to a depth of 3 feet or more. The type is of alluvial origin, being the result of deposition of the finer soil particles from very quiet water. Its formation has also in most places been influenced by conditions of very poor drainage.

The largest area of this soil found in the county occurs along the Lamine River near its mouth, but other small areas are found farther up the Lamine Valley and along Blackwater and Petite Saline, much of that near the town of Blackwater being somewhat lighter and better suited for farming than the typical Wabash clay. This soil is commonly known as gumbo, and is cultivated with considerable difficulty, unless handled when in just the proper condition. When so handled it produces good crops of wheat and grass and is used to some extent for corn. It can, however, be greatly improved by thorough drainage and by cultivation. The yields of wheat and corn are somewhat lower than on the type just described.

Mechanical analyses of the soil and subsoil of this type give the following results:

Mechanical analyses of Wabash clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
22369.....	Soil.....	0.0	0.0	0.2	0.9	1.5	56.4	41.2
22370.....	Subsoil.....	.0	.3	.3	.5	2.9	61.8	34.3

SARPY SILTY CLAY.

The Sarpy silty clay is a yellowish dark brown to almost black silty clay, underlain at a depth of about 14 inches by a very fine sandy loam, light in color and extending to a depth of 3 feet or more. In places thin layers of silt or silty clay are encountered in the subsoil, and in other places the heavy surface soil extends to a depth of 3 feet or more, the subsoil being lighter in color than the surface material, but very plastic and puttylike. The light-textured subsoil, however, seems to prevail over the greater part of the type.

Only a small area of Sarpy silty clay occurs in Cooper County, this being near Wooldridge.

This soil is heavy and cracks and breaks into cubes when dry. It is therefore somewhat difficult to handle, but is a rich, productive soil and well suited to the principal crops of the area, which yield about as well as on the Wabash soils.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Sarpy silty clay:

Mechanical analyses of Sarpy silty clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21593	Soil	0.0	0.1	0.3	2.8	3.8	62.5	30.4
21594	Subsoil	.0	.0	.1	.8	25.6	64.9	8.3

SARPY SILT LOAM.

The Sarpy silt loam, like the Sarpy silty clay, is of alluvial origin, has a level surface, and is subject to occasional overflow. It consists of a yellowish-brown rather heavy silty soil, though lighter both in color and texture than the silty clay, which extends to a depth of about 16 inches, where it is underlain by a lighter-colored fine sandy loam similar to the materials found under the silty clay. In places, however, the heavy surface soil extends to the depth of 3 feet or more. This soil is easily cultivated and very productive. It occurs in only one area located near Wooldridge.

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

Mechanical analyses of Sarpy silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21591	Soil	0.0	0.1	0.2	1.2	1.4	73.7	23.3
21592	Subsoil	.0	.0	.1	11.2	33.0	40.0	15.4

SARPY FINE SANDY LOAM.

The Sarpy fine sandy loam consists of a rather silty fine sandy loam with a depth of about 12 inches, resting on a fine sand. It is an unimportant type in this area, a few small areas only having been outlined along the Missouri River. The principal cultivated area is on Terrapin Island.

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

Mechanical analyses of Sarpy fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
22363	Soil	0.0	0.0	6.0	14.6	32.9	40.7	5.6
22364	Subsoil	.0	.0	.0	63.7	30.5	3.5	2.3

The following samples contained more than one-half of 1 per cent calcium carbonate ($CaCO_3$): No. 22363, 3.72 per cent; No. 22364, 2.84 per cent.

SUMMARY.

Cooper is one of the older counties of central Missouri, the first settlement having been made 100 years ago, and much of the county has been farmed for over three-quarters of a century. It consists of slightly rolling uplands, rather deeply eroded hill country, and stream valleys. It is rather uniformly, though not densely, populated and well supplied with small towns and markets and transportation facilities.

The annual rainfall, which is about 40 inches, is well distributed through the year. The climate is mild and suited for general farming.

Stock raising is combined with grain farming, and with the exception of wheat practically all crops raised are fed on the land. Much clover is raised and considerable attention is given to the rotation of crops. Owing to this method of farming the soils have not deteriorated as rapidly as in some other sections of the country, yet parts of the county have been seriously injured by erosion and continuous grain farming, and more attention should be given to the growing of legumes and the saving of manure. Farm values have advanced rapidly in the past 10 years and the best land is now held at from $70 to $100 an acre. The farmers are in a prosperous condition and the farming as a whole may be considered good.

The soils fall into four broad groups—the upland prairie and closely related soil, the residual limestone hill soils, the loessial soils, and the alluvial soils along the stream bottoms. The loessial and deeper residual soils may be considered the wheat and clover soils and the black prairie and bottoms the corn soils, although all

crops suited to this climate are grown with greater or less success throughout the area.

Corn growing receives much attention and the yield is generally conceded to be increasing. Alfalfa has been tried in several places, but with no very great success. Cowpeas are being grown in many places in the county and will undoubtedly prove a valuable crop, especially when used on the thin ridge and partly eroded soils. Tobacco growing is receiving attention and the outlook for this crop is encouraging.

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