SOIL SURVEY OF COLE COUNTY, MISSOURI.

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DESCRIPTION OF THE AREA.

Cole County, Mo., lies near the center of the State. Jefferson City, in the northern part of the county, is 124 miles by rail from St. Louis and 158 miles from Kansas City. The Missouri River forms the northern boundary and the Osage River a large part of the southern boundary of the county. The included area is 389 square miles or 248,960 acres.

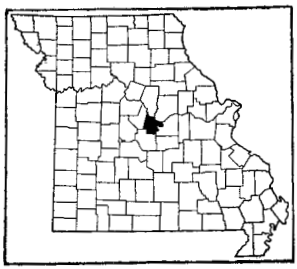

FIG. 44.—Sketch map showing location of the Cole County area, Missouri.

The topography of the county is that produced by erosion of what was originally a comparatively level upland plain. The dissection has been thorough, having advanced until very little of the old level upland remains. The surface, which has an elevation of 750 to 900 feet above sea level, ranges from undulating and gently rolling to hilly, rough, and broken. The general slope is toward the north and east. Along the streams there is some level land forming the terraces and present flood plains. The lower flood plains of the Osage and Missouri Rivers are somewhat more than 500 feet in elevation.

The divides separating the main drainage courses are usually not wide, but in places they broaden into areas of undulating to gently rolling topography. An area of this kind extends southwest of Russellville. Another extends from Bass to the county line north of the Jefferson City and Tuscumbia Road. A third extends from near Elston Church westward to the county line near Centertown. Smaller areas of nearly level and undulating upland are found in many parts of the county, usually along the crests of the divides. In most places, however, erosion has advanced until the divides are merely low, narrow, undulating belts. Many of the principal public roads follow such divides; for example the State Highway from Jefferson City to Centertown, the road from Stringtown to Russellville, the road from Fishtrap Bridge to the county line beyond Hickory Hill, the north-and-south road through St. Thomas, and the road from Osage Bluff through Wardsville, Taos, and Schubert to Osage City. From the highest parts of the divides to the stream valleys the greater part of the land is undulating to hilly. Some of it is rough and broken, but such land is confined largely to rock ledges, to steep bluffs bordering the larger streams, and to small areas around the upper courses of the smaller tributaries. More land is left uncultivated because of the stony nature of the soil than because of

steepness of slope or rough topography. Bordering the Missouri River flood plain is a perpendicular bluff, rock ledge or very steep rocky slope 100 to 200 feet high. Extending south from this is a belt of hilly upland 1 to 2 miles in width, in which the slopes, although steep, are somewhat more rounded, with fewer exposures of bedrock, than in the country farther from the river.

Bottom lands and terraces lie along both the large and small streams of the county. In most places there are narrow strips of low first bottom subject to overflow during high stages of the streams. The flood plains of the more important streams range in width from one-eighth to one-half mile, the average width being more than one-fourth mile. Along the smaller streams the flood plains vary from only a few rods to one-fourth mile, the average width being about 40 rods. The Missouri River flows for the greater part of its course through the county at the foot of a bluff, and has but little flood plain within the county, except in the extreme northwest part, near Marion.

The terraces or second bottoms, where they occur, are separated from the first bottoms by a steep bench or step ranging in height from 5 to 20 feet. These higher terraces are subject to overflow only during extremely high stages of the streams and some have not been overflowed since the settlement of the county. Above these second terraces there are in places, especially at the foot of long gentle slopes that extend into the meanders of the larger streams, still higher terraces separated from the next lower terrace by a steep slope 10 to 30 feet high. An excellent example of this terracing may be seen where Moniteau Creek enters the Missouri River flood plain a short distance west of the railroad bridge. Here, west of the public road, four distinct, well-developed terraces represent earlier stream flood plains.

Along the Missouri River there are traces of still higher terraces, but these have become so eroded that they have lost much of their terrace characteristics. One of these extends from New Marion northwest parallel with the present course of Moniteau Creek to a point beyond the county line, and is separated from this stream by a low ridge, steep on the north side but sloping gently to the terrace on the south. On the opposite side the terrace is bounded by a chain of characteristic river hills. Jefferson City is situated on a small terrace of this kind.

Extending from near the mouth of Moreau Creek to Osage City is a valley with an average width of one-fourth mile, a nearly level valley floor, steep slopes, and the wide-swinging meanders of a large stream valley, but at present no stream flows through its entire course. One small stream drains the west part of the valley, another crosses it near the center, and the eastern part is drained into the Osage River.

This valley, from its size and position, is evidently an old valley of Moreau Creek, which formerly flowed into the Osage River near the present site of Osage City. Another, shorter abandoned valley, probably of Moreau Creek, lies 1½ miles northwest of Lohman.

The drainage of Cole County is directly or indirectly into the Missouri River. The Osage River, the largest tributary of the Missouri in the State, flows through the county for a distance of about 12 miles and forms the eastern boundary and a large part of the southern boundary of the county. The upland section is well drained, and in many places the run-off is so rapid as to result in serious injury from

erosion. In the stream valleys considerable areas are subject to overflow and some need better drainage. The high terraces are also poorly drained, owing to their nearly level topography, the impervious nature of the subsoil, and the seepage from the adjacent slopes.

Settlement of the area which later became Cole County began in the early part of the nineteenth century, and the county was organized in 1820. The early settlers came largely from Kentucky, Virginia, and Tennessee, by way of the Missouri River. Between 1830 and 1850 there was a large immigration of Germans into the region and the present population is predominantly of German descent, though the proportion of persons of this nationality is less in the southwestern and northwestern parts of the county than in other parts.

In 1920, according to the Federal census, Cole County had a population of 24,680, of which less than one-half was rural. The rural population, which includes inhabitants of towns of less than 2,500, is distributed fairly uniformly throughout the county. The average density of the rural population is 26.2 persons per square mile.

Jefferson City, the capital of the State and the county seat of Cole County, has a population of 14,490. It is situated in the northern part, on the Missouri River, and has important manufacturing, railroad, and commercial interests. Marion, Centertown, and Elston in the northwestern part of the county, Lohman and Russellville in the western part, Eugene and Henley in the southwestern part, and Osage City in the northeastern part, are all railroad shipping points and trading centers for the surrounding communities.

Cole County is fairly well supplied with transportation facilities. The main line of the Missouri Pacific Railroad traverses the northern part of the county. The River Division of this road extends from Cole Junction through the northwestern part. The Bagnell Branch traverses the western part, and the Chicago, Rock Island & Pacific Railway passes through the extreme southern part. All of these lines furnish direct communication with St. Louis and Kansas City, the principal markets for the products of the county. Along the Osage River grain is shipped by boat.

Owing to the rough topography, the public roads were first laid out along the most accessible routes, usually following the ridges, and this practice is still followed to a great extent. State Highway No. 2 crosses the northern part of the county, entering it near Centertown, passing through Jefferson City, and leaving it at Hubers Ferry. This road and a few other roads of the county are in fair condition, but many are in poor repair and are almost impassable in bad weather.

Mail is carried by rural free delivery or by star routes into nearly all parts of the county.

St. Louis, Kansas City, and Chicago are the principal markets for products shipped into and out of the county.

CLIMATE.

The climate of Cole County is characteristic of central Missouri. The mean annual temperature is 54.8°F. The average date of the last killing frost in the spring is April 18 and that of the first in the fall October 16, giving a growing season of 181 days. During late spring and early summer the weather is often hot, but rainfall during

this season is usually sufficient to prevent injury to growing crops. The growing season is sufficiently long for the maturing of all ordinary farm crops and also permits the growing of cowpeas or soy beans after wheat, oats, or early potatoes have been harvested. Alfalfa can be cut three or four times, and bluegrass often affords excellent pasturage until the end of November or early in December.

Fruit is sometimes injured by heavy frost following periods of warm weather in late winter or early spring, but is rarely a total failure, and poor crops are more often due to lack of proper care than to climatic conditions.

The average annual rainfall—36.03 inches as recorded at Jefferson City—is well distributed for agriculture, being heavier in the spring and summer and lighter in the fall and winter. There is an abundance of moisture for all crops grown in this region, if proper steps are taken to conserve it. Occasionally excessive rain in the spring is followed by periods of unusually dry weather, thus preventing the planting or proper cultivation of some crops. Dry, hot winds occasionally injure the corn, and dry, hot weather in the fall may kill young clover, but on the whole the climate is well suited to the system of grain and stock farming followed.

The following table, compiled from the records of the Weather Bureau station at Jefferson City, gives the important climatic data for Cole County:

Normal monthly, seasonal, and annual temperature and precipitation at Jefferson City.

(Elevation, 557 feet.)

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1901).	Total amount for the wettest year (1898).
	°F.	*°F.*	*°F.*	*Inches.*	*Inches.*	*Inches.*
December	33.0	73	−24	1.96	3.85	1.63
January	30.2	77	−23	2.38	1.60	4.61
February	30.8	84	−25	2.24	2.23	1.70
Winter	31.3	84	−25	6.58	7.68	7.94
March	42.7	93	−2	2.76	3.80	6.37
April	56.8	96	21	3.50	2.59	3.94
May	65.2	99	28	4.46	0.65	8.35
Spring	54.9	99	−2	10.72	7.04	18.66
June	74.0	105	41	4.21	1.50	5.63
July	78.1	114	50	3.62	1.06	3.97
August	76.7	109	44	2.94	2.12	1.67
Summer	76.3	114	41	10.77	4.68	11.27
September	69.0	105	30	3.22	0.95	6.79
October	56.7	95	19	2.41	1.40	3.89
November	44.4	87	6	2.33	1.21	3.33
Fall	56.7	105	6	7.96	3.56	14.01
Year	54.8	114	−25	36.03	22.96	51.88

AGRICULTURE.

Cole County is exclusively an agricultural region. Corn, wheat, clover, and oats are the principal farm crops. To these may be added alfalfa, timothy, redtop, potatoes, sorghum, cowpeas, soy beans, and a few other crops of less importance. Melons and garden truck are grown for the local market.

Stock raising is carried on to some extent on almost every farm and there are several small herds of registered and high-grade cattle and hogs, but there are few large stock farms. Nearly every farmer raises a few cattle, hogs, horses or mules, and poultry, and many keep small flocks of sheep. Nearly all have cows to supply butter and milk for home use, and a good many have small dairy herds.

The principal sources of income are wheat, corn, livestock, poultry and poultry products, hay, clover seed, and dairy products. To these may also be added, potatoes, sweet potatoes, sorghum, and wood.

Wheat is the most important cash crop of the county. According to the census, the decennial acreage from 1879 to 1909 ranged from a little less than 22,000 acres to slightly more than 28,000, with an average yield of approximately 13 bushels per acre. In 1919 wheat was grown on 36,160 acres, which yielded 553,588 bushels, or an average of 15 bushels per acre. This larger acreage was due in part to the stimulus of war prices.

Wheat is grown on nearly every farm and on practically every type of soil. If the crop follows a small grain, the land is plowed as soon as possible after the grain is removed, to a depth of 4 or 5 inches, and then immediately disked to form a mulch and conserve the moisture. Some farmers disk as soon as the grain is removed, thus conserving the moisture and keeping the soil from becoming hard and dry. After it has been plowed and disked, the land is allowed to lie until late in September or early in October, when it is again thoroughly disked to form a fine, compact seed bed. When wheat follows corn, the corn is cut and shocked or put into a silo and the land thoroughly disked, but usually not plowed before seeding. In order to avoid injury from the Hessian fly, many farmers seed wheat as late in the fall as possible, and only early enough to get a sufficient growth before freezing weather. Fultz and Red Chaff are the principal varieties grown. Timothy and redtop are often seeded with the wheat, but clover is not usually sowed on the wheat ground until spring. Teams of two, three, or four horses and tractors are used in preparing wheat ground. Wheat is cut with self-binders and usually threshed from the shock, although some of it is stacked.

Corn is grown to about the same extent as wheat, but, unlike wheat, it is largely used in fattening hogs or cattle for the market. According to the census for the 30-year period preceding 1910, the decennial acreage and production have ranged from 21,324 acres, with a yield of 586,157 bushels, in 1879 to 26,615 acres, with a yield of 827,232 bushels, in 1909, the yield per acre ranging from 24 to 27 bushels. In 1919 corn occupied 24,053 acres and yielded 552,831 bushels, or an average of 23 bushels per acre.

Corn is grown on every farm in the county. Land to be planted to corn is plowed to a depth of 6 to 10 inches, either in the fall or as soon as the soil becomes dry enough in the spring. It is then worked

down with a disk or drag harrow and the seed planted on a level surface, usually with a two-row planter. Some is check-rowed, but much of it, especially in the bottoms, is planted in drills. On the uplands corn is planted from April 15 to June 15, while in the river bottoms it is sometimes planted as late as July 1. It receives from three to five cultivations and is laid by in ridges. Reid Yellow Dent is the variety most extensively grown on both the uplands and bottoms, although some Boone County White, Johnson County White, Cartner, and other varieties are grown.

In 1919 there were 7,585 acres sown to oats, with a yield of 145,313 bushels, or an average of 19 bushels per acre. According to the census, the decennial acreage for the past 40 years has been fairly constant, and the yield has ranged from 18 to 25 bushels per acre. The Red Rustproof is the leading variety.

Clover is an important crop of Cole County, being the only soil-building crop in general use in the rotation. It usually follows wheat, being sown on the wheat in early spring as soon as danger of freezing is past. If the season is favorable, with an abundance of moisture, the clover may be cut in the fall following the harvesting of wheat. If not cut, it makes good fall pasture, or may be plowed under and corn planted the next season. Generally it is allowed to stand, making two cuttings the next season. The first cutting is used for hay; the second is often cut and threshed for seed, which yields from 1 to 3 bushels per acre. Clover takes nitrogen from the air; this is returned to the soil through the decay of roots and stems when plowed under. Corn, which requires much nitrogen, usually follows clover. Common red clover is grown principally, but mammoth clover is grown occasionally, and alsike clover is used on wet, sour soils. Ground limestone has been used to good advantage on fields where it was difficult to get a stand of clover.

Lespedeza, or Japan clover, makes a dense growth in the pastures throughout the county and furnishes considerable excellent grazing. It is never sown in this region, having recently spread over much of the country in its northwest spread from the south.

Clover and timothy mixed were grown in the county on 2,424 acres in 1919, and timothy alone occupied 12,371 acres.

Alfalfa has not been grown very extensively, but the acreage is increasing. It was reported on 954 acres in 1919, with a production of 1,834 tons of hay. Alfalfa is grown most extensively on the brown bottom-land soils and the upland soils of loessial origin, but it can be grown on any soil well suited to red clover if the soil is fertilized, limed, cultivated until free of weed and grass seed, and inoculated. Three or four cuttings, depending on the season, are obtained each year.

Cowpeas and soy beans are grown to a very small extent. On the light-colored bottom soils and poor upland soils these crops offer an excellent substitute for clover, and should be grown much more extensively.

Potatoes are a rather important minor crop of Cole County. They are grown largely for home use and for the local market. The census reports 644 acres of potatoes in 1919, with a yield of 42,523 bushels. Sweet potatoes the same year occupied 105 acres.

Sorgo (sweet sorghum) is grown on many farms for home use and for sale locally. Kafir, milo, feterita, broomcorn, and tobacco are also grown to a small extent. On the light sandy soils of the Missouri River bottom a considerable acreage of watermelons is grown.

Although the soils and topography of Cole County, especially that part adjacent to the Missouri River lowlands, are well suited to fruit, very few orchards are to be found, and the greater number of these seem to be badly neglected. A few small but thrifty looking vineyards were noted.

In January, 1920, there were in the county, as reported by the census, 10,719 beef cattle, 6,505 dairy cattle, 20,953 hogs, 3,739 sheep, 4,380 horses, and 2,455 mules.

In general, the farmers recognize the adaptation of crops to certain soils. This is especially true of the German farmers, who cultivate the bottom lands and suit each soil to a particular crop. The low first bottoms are planted to corn, the white second bottoms are used largely for wheat, strips of lower land only a few rods wide through a field of wheat are carefully cultivated and planted to corn or sown to oats, timothy, or redtop. Clover is grown on rich, well-drained soils, where it will do best. The same is true of alfalfa. Some farmers who have poor hill land that will not grow clover build it up by using a cover crop of rye and following this with soy beans or cowpeas. The black upland soils are used for corn, wheat, and oats, but not for clover. Rocky hill land is used largely for pasture.

The greater part of the farm work of Cole County is done with teams or tractors and farm machinery. Not a great deal of handwork is done. Wheat and oats are cut with binders and usually threshed from the shock. A considerable part of the corn is cut by hand and shocked. A few corn binders are used. Some farmers husk the shocked corn and remove the fodder before seeding to wheat. The rest of the corn is husked in the fields and put into cribs, and the fields are pastured with cattle and hogs. Some hay is stacked in the open in large ricks, but more of it is put into barns.

Farm buildings and equipment are generally good. Most of the houses are large and well built, some of stone. One or more barns with stone basement are often built on a hill slope. The fences are largely of woven wire, although some rail fences are used. A good many farms have one or more silos. Tractors, manure spreaders, automobiles, and other modern machinery are in common use.

Very few farmers follow a fixed scheme of crop rotation, but adjust the rotation to seasonal conditions and their convenience. On the rich first-bottom lands corn is often grown for several years in succession. On the poorer upland soils the better farmers follow each crop of corn with some other crop, and on the better soils do not plant more than two crops of corn in succession.

The most common rotation is corn one or two years, followed by wheat, or by oats, and then wheat. Clover or clover and timothy are sown in the wheat. After the second year of clover the land is again planted to corn. When timothy is sown it may be cut for hay one or more years. Bluegrass is not usually seeded, but meadow or forest land which is pastured gradually develops a stand of bluegrass. Well-established bluegrass pastures are used for many years without change.

Prior to 1914 commercial fertilizers were used in rather small quantities in Cole County, the census reporting an expenditure of only $3,061 in 1909. Since 1914 there has been a considerable increase in their use, and the outlay for fertilizers in 1919 rose to $27,655. Fertilizers are used largely in seeding the small grains. Applications are light, ordinarily 100 to 125 pounds on wheat. Treated rock phosphate, raw rock phosphate, and complete mixtures high in phosphate are the fertilizers most commonly used.

All available manure is applied to land intended for corn or wheat, or to the thin places in the pasture land. Very little ground limestone is used.

Most of the farmers depend on their own labor and that of their families during most of the year, and on exchange work with neighbors when much help is needed, as in threshing or in filling silos. Farm laborers are paid $40 to $45 a month, with board. Day laborers receive $2 to $2.50, and during harvest considerably more, as much as $4 to $4.50 being paid in 1919.

According to the census, 93.4 per cent of the area of Cole County is included in 1,621 farms, with an average size of 143.4 acres. Most of the farms range in size from 40 to 320 acres. Nearly 83 per cent of the farms are operated by the owners.

Land prices range from $20 to $35 an acre, where a large part of the land is rough and broken and not well located, to about $150 for the better land near the larger towns or along the improved highways. The average price for medium to good upland soil, or upland with some bottom land, with fair improvements, is $60 to $75 an acre. Much of the land, particularly the better bottom land held by German farmers, is not for sale at any price.

SOILS.[1]

The soils of Cole County may be placed in three broad groups—residual, loessial, and alluvial—according to the mode of accumulation of the materials from which the soils are developed.

The residual soils are formed from materials accumulating from the disintegration and weathering of underlying rock beds,[2] which in Cole County consist mainly of limestones of the Burlington, Jefferson City, and St. Elizabeth formations.[3] The first of these underlies a small area in the northwestern part of the county, the second is the country rock extending over by far the greater part of the county, and

[1] The mapping in Cole County does not join well with the mapping in Miller County. This is on account of the advance that has been made in soil differentiation since Miller County was mapped in 1912. The soil mapped as Clarksville silt loam in Miller County is now known to differ rather widely from the typical Clarksville silt loam, which occurs mainly in the southern Appalachians. This was discovered after Miller County was mapped. It also was discovered that the Clarksville silt loam in Miller County is really identical with the Union silt loam and that the Clarksville stony loam in Miller County is identical with the Baxter stony loam. Cole County was mapped, therefore, in accordance with this knowledge of the relationship of these soils to one another, so that the Clarksville silt loam in Miller County is continued on the Cole County map as Union silt loam, and the Clarksville stony loam as the Baxter stony loam. In the northwestern part of Miller County a large area was mapped as Lebanon silt loam. A more careful study of this area in Cole County has shown that it belongs to the Union series rather than to the Lebanon series, and has been so mapped in Cole County. The Lebanon soils, therefore, in Miller County, are now known not to be Lebanon, but Union. They differ from the true Lebanon soils in the absence of the typical Lebanon hardpan in the deep subsoil.

[2] There are a few small pockets of coal in the county. These pockets are believed to be fragments of a much larger body which formerly extended over the area, but was long ago removed by erosion. In the pockets associated with the coal are small masses of thin-bedded limestone and shale, but these are not of sufficient extent to influence the formation of the soil.

[3] Missouri Geological Survey, Miller County.

the third is present only in a small section in the southern part of the county.

The Burlington limestone consists of beds of blue to gray crystalline limestone well filled with fossils, alternating with thin beds and lenses of chert. The Jefferson City formation includes rock beds belonging to the Upper Magnesian. There are in this formation several beds from a few inches to as much as 2 feet thick, of pale-yellow or buff, soft, fine-grained limestone called "cotton rock," and intervening thin beds of gray or green shale. The formation is exposed in many bluffs, steep hill slopes, in the bottom of gullies and streams, and in a few places as small "glades" or areas of bare or almost bare rocks. Near the upper part of the formation there is a thick, heavy bed of dolomite, a rock in which the principal constituent is magnesium instead of calcium. This weathers into a pitted surface through the solution of the softer parts and is known as pitted dolomite. This rock is more resistant than the cotton rock. Chert also occurs in these beds and irregular masses throughout the Jefferson City formation.

The beds of gnarled chert and limestone, with thin alternating beds of sandstone, in the southern part of the county, have been called the St. Elizabeth formation.[4] In this the chert is more abundant and apparently more resistant than in the Jefferson City formation.

These various rocks give rise to materials that form the Union, Eldon, and Baxter soils of the upland, but the relation between the soils and rocks is not direct and invariable; the material coming from one kind of rock may give more than one type of soil, or one type of soil may develop from several different rock conditions; the soils do not represent simply the rock material in a disintegrated state, but are the products of evolution brought about by natural forces working on the rock material under variable conditions of climate, of slope, of drainage, and of vegetation. Rock materials subjected to influences of a forest cover give soils of certain characteristics; under a cover of prairie vegetation, entirely different characteristics; under well-drained forest conditions, one set of characteristics; under poorly drained prairie conditions, another set; and so on. Thus arise the multiplicity of soil types and the wide range in their agricultural value and use.

A good example of the change that may take place in rock material during the processes of soil formation occurs in Cole County, where the dark-colored soils around Russellville and Hickory Hill are derived from the same original material as the lighter colored soils in the central and eastern parts of the county; the former have developed under prairie conditions and the latter have developed under forest conditions.

The soils derived from the consolidated rock formations cover approximately three-fourths of the area of the county and occupy all the upland area except a relatively small strip in the northern part, in which the soils are developed from an unconsolidated deposit known as loess, which will be discussed later. Brief descriptions of the soil series correlated with the disintegration products of the indurated rocks of the areas follow:

[4] Missouri Geological Survey, Miller County.

The types of the Union series are formed by the weathering of dolomite and limestone which are chert-free, or in which the chert has to a considerable extent broken down. They are characterized by light-brown, grayish-brown, or yellowish-brown surface soils and yellow to light buff colored subsoils, with moderate to intensive mottling of gray, and containing more or less of rusty-brown to nearly black concretionary material. The Union soils have developed under forest conditions not favorable for the accumulation of organic matter. Two types have been mapped in Cole County—the Union silt loam and the stony loam.

Throughout this county there are small areas of soil which have a gray or brownish-gray to brownish-red surface and red to reddish-brown subsurface. The subsoil is typically brick red, consisting of moderately stiff clay. These soils are residual from limestone and have been correlated with the Baxter series. Two types—the silty clay loam and the stony loam—are mapped.

The Eldon soils have been derived from residual limestone material under prairie conditions favoring accumulation of organic matter in the soil by decay of grass and grass roots. They have dark-brown to black surface soils, a yellowish subsurface, and a subsoil of yellowish-red, stiff, plastic, heavy clay; more plastic than the subsoil of the Baxter series and very much more plastic and heavier than the subsoil of the Union series. Two types—the Eldon silt loam and gravelly loam—have been mapped.

The northern part of the upland bordering the Missouri River flood plain is covered by a thin deposit of material known as loess. The origin of this material is more or less uncertain, but it is believed to have been blown over the uplands from the flood plains during Pleistocene times and deposited in a fairly uniform layer regardless of the topography. It is thickest near the river. In Cole County the loess deposit is much thinner and also less extensive than in the Missouri River counties farther west. The material is not calcareous either in the soil or subsoil. The low content of lime is probably due to the leaching this loess has undergone since it was deposited. The loess in Cole County was probably much more extensive and deeper than at present, and has been reduced in depth and extent by erosion. It occupies a strip varying in width from 1 to 3 miles, but its southern limit is indefinite. It occurs in isolated areas at considerable distances from the river, and its influence on the soils in the northern part of the county has undoubtedly been considerable. The loess soils of this region have been classed with the Memphis series. The silt loam is the only type mapped in Cole County.

The materials forming the alluvial soils of the present survey have come principally from two sources: (1) They have been eroded from the upland soils of the region farther south and west and deposited in the valleys of the small streams and of Moreau Creek and Osage River; (2) in the Missouri River flood plain they have come largely from the glaciated and loess-covered region to the north. The flood-plain soils in the valley of the Osage River and the smaller streams belong to the Huntington series. The old-alluvial or terrace soils belong to the Robertsville, Bagnell, and Elk series. The Elk series is the terrace correlative of the Huntington, and the Bagnell series includes black terrace soils closely related in origin to the Elk. In

the Missouri River bottom the soils are classed mainly in the Sarpy series.

The characteristic arrangement of the soils in the smaller bottoms is shown in Plate XXVI, Figure 1.

The surface soils of the Robertsville series are light gray in color, almost white when dry, and underlain by a whitish or bluish-gray or mottled whitish, bluish-gray, and pale-yellow subsoil. Locally the lower subsoil is compact and high in dark-colored concretionary material, having the nature of a hardpan, which causes the drainage to be poor. The series is represented in this county by the silt loam type.

The Bagnell series includes types with dark-brown to black surface soils and a grayish or dark bluish gray subsoil. Two types of this series—the silt loam and the clay—are mapped.

The Elk series has light-brown surface soils and a yellowish-brown subsoil. The silt loam is the only type of this series mapped.

The Huntington series comprises brown first-bottom soils with lighter colored friable subsoils. The material consists chiefly of local wash from limestone soils, with a considerable contribution from the loess.

The Sarpy soils are brownish in the surface and lighter both in color and texture in the subsoil. Three types—the very fine sandy loam, silt loam, and clay—are developed in Cole County.

In the following pages of this report the various soils of Cole County are described in detail. The table below gives the actual and relative extent of each soil mapped:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Union silt loam	73,152	45.3	Baxter silty clay loam	4,864	2.0
Deep phase	39,488		Sarpy very fine sandy loam	2,368	.9
Union stony loam	48,832	19.6	Eldon gravelly loam	2,304	.9
Huntington silt loam	19,456	8.8	Sarpy silt loam	2,048	.8
Heavy-subsoil phase	2,624		Sarpy clay	1,152	.5
Memphis silt loam	19,136	7.7	Bagnell clay	832	.3
Robertsville silt loam	6,016	5.6	Bagnell silt loam	640	.3
Low-terrace phase	7,872		Riverwash	640	.3
Baxter stony loam	10,304	4.1	Elk silt loam	448	.2
Eldon silt loam	6,784	2.7			
			Total	248,960	.....

UNION STONY LOAM.

The Union stony loam consists of a pale greenish gray or light yellowish brown to light-brown silt loam, grading into yellowish silty clay loam or silty clay at about 3 to 10 inches below the surface. This passes into yellow, yellowish-brown, or buff-colored silty clay, mottled in many places with gray. This layer may extend to a depth of 3 feet, but is prevailingly underlain at 12 inches or less by bedrock, either chert, limestone, dolomite, or sandstone. Fragments of chert ranging from a fraction of an inch to a foot or more in diameter are found on the surface and throughout the soil profile.

The type has a wide range of variations. It includes areas in which the gray to yellowish-brown mottled silty loam and silty clay carry rather small chert fragments in quantities not too large to prevent cultivation. Such areas, if of sufficient extent, would have been mapped as Union gravelly loam. Other areas, in which the surface soil is gray to reddish gray and the subsoil a deep red or brick red, represent Baxter gravelly loam and stony loam. In general, these areas, which are mere patches, are more abundant in the southern, southeastern, and extreme northwestern parts of the county than elsewhere. Some included areas have a yellowish-brown or light-brown silt loam surface soil with a subsoil of red, yellowish-red, or reddish-yellow, plastic, sticky, heavy clay, in places mottled with gray or yellow. The subsoil beneath these areas is much more plastic than that of the Baxter, which when moderately moist is brittle rather than plastic.

The Union stony loam also includes areas of Boone fine sandy loam, loam, and stony loam in which the soil is gray to light brown and rather sandy. Such areas are most abundant in the region extending south from Jefferson City to the Osage River, but are found in other parts of the county. A few small areas of dark-colored or nearly black soil, in most places shallow and overlying beds of "cotton" rock or dolomite, represent an inclusion of the Gasconade series. The Union stony loam also includes many nearly perpendicular bluffs and a few small "glades"—areas in which bare rock masses are exposed or only thinly covered with soil. There are also some included areas of nonarable Rough stony land. In a few places, usually on the tops of hills or on the north slopes, narrow strips and small areas of practically rock-free soil represent another variation which, if occurring in larger areas, would be mapped as Union silt loam.

In the southern and southeastern parts of the county the Union stony loam is the most extensive type. Smaller isolated areas are found in all parts of the county. The type occurs principally over the higher parts of the divides, like those near Hardscrabble School and south of Brazito, or occupies the steep slopes near the larger streams, as along Moreau Creek, or forms a narrow rim surrounding the smaller stream valleys, with areas of Union silt loam above and below it. Many small, irregular areas are at the heads of small streams where rapid erosion has removed the softer material and exposed the hard, cherty mass.

The topography of the greater part of this type is hilly, and in places it is rough and broken. Surface drainage is good to excessive.

Agriculturally the type is of slight importance; probably less than 5 per cent of it is under cultivation, the rest being in forest or brush. The growth is mainly post oak, but in places includes white oak, some blackjack oak and red oak, black hickory, and a scattering of other trees. White oak and red oak grow on the better areas, especially on the north and east slopes. Nearly all the saw timber has been removed, leaving only the smaller trees and brush. The remaining trees furnish fence posts, mine timbers, and firewood. The type is used to a considerable extent for pasture, but on account of the shallow soil the grass burns out rather badly in hot, dry weather. The principal pasture plants are lespedeza, bluegrass, and native wild grasses.

Farms on which this is the predominating type can be bought at prices ranging from $20 to $50 an acre. Nearly all upland farms include some of this land.

Much of the type can be made more profitable by clearing and seeding to bluegrass, redtop, or orchard grass for permanent pasture. Parts of the type, especially those supporting a good growth of white oak, can, by cutting out the worthless trees and brush, be profitably used for future timber supply. Small areas in which the percentage of stone is low can be cultivated and used for strawberries, raspberries, and in some locations for apple orchards.

UNION SILT LOAM.

The typical Union silt loam in some respects resembles the Memphis silt loam, but it is somewhat lighter brown in the soil, is more mottled with gray, and contains more dark-colored concretionary material in the subsoil. The agricultural value, also, is lower than that of the Memphis.

The Union silt loam, which occupies the greater part of the stone-free uplands in Cole County, may be described in general as consisting of four layers. The surface soil is a brownish-gray to light yellowish brown or light-brown silt loam, grading into heavier and more yellowish silt loam at about 6 to 10 inches. The subsoil, beginning at 10 to 12 inches, is a yellow or brownish-yellow friable silty clay loam, with faint gray mottling in places. This passes at a depth of about 18 to 20 inches into silty clay of yellow, slightly reddish yellow, or light-buff color, with moderate to intensive mottling of gray, containing variable quantities of rusty-brown or nearly black concretionary material. Usually the subsoil below 28 inches is more silty and more friable than the upper subsoil. In places this lower subsoil is profusely mottled with gray, yellow, dark brown, and almost black, the last two caused by concretionary material. The texture is usually a light silty clay loam. Where the gray mottling is most conspicuous and the content of concretionary material high, the subsoil is most compact, in places having essentially the nature of a hardpan. This compact layer acts as an obstruction to underdrainage, and probably impedes internal movement of both moisture and air.

The type contains numerous other variations, and it is not uncommon to find several different variations even in a small field. The differences are due primarily to two causes—lack of uniformity in the soil-forming material and differences in the degree of weathering and erosion since the soil was formed.

One of the most noticeable variations in this soil, as mapped, consists of what is known as "white," "crawfishy," or "buckshot" land. Such land occurs on flat and gently sloping areas where the surface and subsurface are distinctly more grayish in color, apparently as the result of imperfect oxidation due to the retarded subdrainage. In this variation the surface is light gray or almost white, and the soil is specked with black and brown. The subsoil is compact and rather impervious. On the surface and in the soil and subsoil are varying quantities of dark-colored small concretions or "buckshot." In places accumulations of concretionary material in the subsoil form a more or less firmly cemented hardpan. Such areas occur through-

out the type wherever surface drainage is not good, as in flat areas, slight depressions around the heads of small streams, or on long, gentle slopes. These areas, many of which are small, probably represent inclusions of another type rather than a variation of the Union silt loam.

Another variation occurs where the soil mantle has a depth of less than 3 feet. On top of some of the ridges, on the steep slopes bordering the small valleys, in places around the heads of small streams, and in some other places, masses of mixed chert and soil are encountered within the 3-foot depth, either because the hard underlying material has resisted weathering or because the surface covering has been partly eroded. In places where this rocky mass comes near the surface, the surface soil contains more or less gravel. On some of the higher uplands it was found impossible to penetrate this gravelly mass with the soil auger, indicating that it might be cemented into a hardpan.

On many points and ridges where conditions favor erosion, especially on the slopes extending into the meanders of the large streams and adjacent to areas of stony or gravelly loam, the surface covering of light soil is shallow and the subsoil has a deeper reddish brown color and a heavier texture than typical. There are also spots of light-brown to yellow "gumbo" or clay, and on long slopes, usually where there has been some seepage, there are small areas of heavy dark-colored soil, which, if of sufficient extent would be mapped as Gasconade.

Near the Misssouri and Osage Rivers the type resembles the Memphis silt loam, but as the higher areas farther from the river are reached it has a more distinctly gray color in the cultivated fields, the topography is more broken, the soil is slightly less productive, and the type approaches in general appearance the soils of the Lebanon series. This is especially noticeable in the region between Eugene, Henley, and Hickory Hill. That part of the type most closely resembling the Memphis soil is shown as a deep phase of the Union.

The Union silt loam extends over the uplands of almost the entire county. It varies in topography from rolling to hilly. Practically none of it is flat and very little is too steep for profitable cultivation. The larger areas, which are more nearly level or occur on long slopes, have poor surface drainage or restricted underdrainage.

A large part of the type, probably over 95 per cent, is under cultivation. It was formerly in heavy forest, consisting of post oak, red oak, white oak, with a little blackjack oak, black and shellbark hickory, elm, hackberry, and walnut.

The important crops are wheat, corn, clover, oats, and bluegrass. Minor crops include timothy, redtop, sorghum, millet, rye, potatoes, and orchard and garden crops. The yields on the type as a whole are not large, wheat averaging 12 to 16 and corn 20 to 35 bushels per acre, although considerably larger yields are obtained by farmers who keep their soils in a good state of fertility.

Considerable livestock is kept on this type and the manure is carefully used. Commercial fertilizer is used by some farmers on wheat at the rate of about 125 pounds to the acre, but clover is depended upon principally to maintain the fertility of the soil. Soy beans and cowpeas are grown on the worn lands where clover does not do well.

The medium to better grades of this land sell for $50 to $75 an acre, depending on the character of the improvements and the distance from roads and markets.

Considerable trouble has been experienced by many farmers during the last few years in getting a stand of clover, owing in part to unfavorable climatic conditions but mainly to acidity of the soil and, in many cases, to lack of organic matter. Although the soils of this region are largely of limestone and dolomite origin, weathering and leaching have reduced the lime content until now practically all of the upland soils are sour. This can be corrected by the application of crushed limestone. Experiments have shown that the local limestone is well suited for agricultural lime. The Union silt loam should receive an application of 2 to 4 tons of crushed limestone once every six to eight years. Clovers should then be grown to as great an extent as possible. Cowpeas and soy beans may be profitably grown in the corn or as separate crops and are almost as beneficial to the soil as clover. These legume crops take nitrogen from the air and store it in the soil.

The type is deficient in organic matter, the natural store of which has been depleted by continuous cropping. This can be supplied by putting the land in grass and pasturing it, by applying manure, by plowing under weeds, grass, straw, and stalks, and by sowing and plowing under cover crops of rye.

The use of commercial fertilizers is as yet very much neglected in Cole County, particularly by the grain farmers. Approximately 500 tons of fertilizer are used each year, mainly on wheat. This indicates that the great majority of the small grains are grown without fertilization. To supplement manure and to reinforce manure, fertilizers should have a much more extended use. The brown limestone soils of this region are naturally low in phosphorus, and this element is present in smaller proportions than either nitrogen or potassium in animal manure. The use of acid phosphate at the rate of 200 to 300 pounds per acre on wheat can be depended on to give profitable returns. Not only does it increase the yield, but also hastens maturity, which is a valuable feature where clover has been sown in the wheat. With the use of fertilizer on the small grains, and by following a rotation of crops which include clover at least once every four years, the Union silt loam can be kept in a fairly high state of productiveness. The soil that is well supplied with organic matter generally has enough available potash for good plant growth, so that this element need not be supplied as a fertilizer.

More effective measures should be used to check erosion. Contour plowing and cultivation should be practiced to as great an extent as possible. The depth of plowing should be gradually increased to check the run-off and give the soil a larger water-holding capacity. A winter cover crop of rye will prevent erosion, afford winter and early spring pasture, and when plowed under add humus to the soil. Broad drainage ways should be seeded to redtop, and when gullies and washes begin to form, they should be filled and seeded to grass. The steeper slopes should be seeded for permanent pasture. Parts of the type can be improved by constructing drains, either open ditch or tile.

Union silt loam, deep phase.—The Union silt loam, deep phase, is a yellowish-brown, loose, friable, silt loam, with a depth of 10 to 12

inches, grading into a clay loam or silty clay loam, mottled with gray and brown. Below 28 or 30 inches the mottling is dark brown to nearly black and the soil is a friable silt loam.

In general, the surface soil is slightly darker and browner in color and contains less gray material and the upper subsoil contains less gray mottling and less fragmental rock and gravel than in the typical soil. The depth of soil material above bedrock is also greater in the phase.

This phase represents a strip of gradational soil lying between the Memphis silt loam and the typical Union silt loam, and sharp boundaries can not be drawn between the two. Southward from the Missouri River there is a gradual, almost imperceptible change from the more productive soil of the deep phase to the less productive and slightly more grayish typical soil. The same gradual merging takes place between the deep phase of the Union silt loam and the Memphis silt loam to the north, and aside from the greater amount of gray mottling and concretionary material in the subsoil of the Union, it is difficult to see any difference in the physical features of these two soils. It is not improbable that much of the soil material of the more northerly areas of the Union silt loam has been deposited in the same manner as that of the Memphis, and that it is of loessial origin down to the depth where material clearly of residual origin, such as chert and sand, is found in the subsoil.

The phase occurs, interspersed with numerous patches of other soils not separated on account of their small extent, in a broad belt across the northern part of the county. In general, the deep phase is best developed along the tops of the divides and low ridges. Its crop value is slightly higher than that of the typical Union silt loam.

BAXTER STONY LOAM.

The Baxter stony loam comprises very gravelly and stony slopes and ridges that are mainly forested. The soil, which has a depth of 5 or 6 inches, is a gray to brownish-gray silt loam; the subsurface, extending to 8 or 10 inches, is a pale-yellow to reddish-yellow silty clay loam; and the subsoil is a fairly stiff, brick-red clay, which is sticky when moist and brittle to moderately tough when dry. In places there is no intermediate or subsurface layer of silty clay loam. Chert fragments are present on the surface and through the soil and subsoil, but they are most abundant in the lower subsoil. Ledges of the parent rock outcrop in places. The type, as mapped, includes patches of Baxter gravelly loam. The principal areas occur along the slopes of the Osage River, in the southern part of the county.

BAXTER SILTY CLAY LOAM.

The Baxter silty clay loam is a reddish-brown silty clay loam, 2 to 6 inches deep, overlying a rather stiff, brick-red clay, which is sticky and plastic when wet and brittle to rather tough when dry. In places the soil is a light-brown, grayish-brown, or yellowish-brown silt loam to a depth of several inches, but deep plowing turns up the clayey subsurface, giving the soil a clay loam texture.

Small angular chert fragments are present locally in small quantities and in places are sufficiently abundant to make the soil a gravelly loam. In places the bedrock, usually limestone or dolomite, is reached

within the 3-foot section. The type is closely associated with the Union and Baxter stony loams, and the soil appears to consist of material recently exposed by erosion, and therefore not subjected to leaching and weathering long enough to develop into Union silt loam.

Owing to its small extent, this type of soil is not important. It occurs in small, irregular areas on the uplands, usually close to and almost immediately above the steep rock ledges. In places it occupies a part of the uplands extending into the meanders of the larger streams, and in other places it lies upon the tops of the drainage divides or is developed in long, narrow strips on the slopes between the lower part of the small stream valleys and the surrounding rim of rocky soils. Such areas are found in several of the small valleys near Osage Bluff. Many areas of this type too small to be separately outlined have been included with the Union silt loam and Baxter stony loam.

The Baxter silty clay loam is well suited to corn, wheat, and clover, the yields usually averaging slightly better than on the Union silt loam.

ELDON GRAVELLY LOAM.

The Eldon gravelly loam is a dark-brown to black silt loam grading at 6 to 10 inches into a dark yellowish brown gravelly clay loam to clay, and passing into mottled red and yellow heavy clay at about 20 inches. Chert gravel is present in considerable quantities on the surface and through the surface soil and in places is so abundant in the subsoil as to prevent the making of deep borings. There are, however, in most places, fewer chert fragments in the lower subsoil than in the upper.

The type as mapped includes some areas with a dark-brown soil to a depth of 5 to 8 inches, below which the material resembles a gravelly phase of the Union silt loam. Areas of this kind are found near Russellville.

The type is mainly in pasture. The small part under cultivation is used for the same crops and gives about the same yields as the Eldon silt loam.

The Eldon gravelly loam is closely associated with the silt loam, occurring usually on the more rolling areas and especially on the steep slopes near the small streams. More of it than of the silt loam is forested, the growth consisting largely of laurel oak.

ELDON SILT LOAM.

The Eldon silt loam is a very dark brown to nearly black silt loam, underlain at about 8 inches by a yellowish-brown silty clay loam and this at about 18 inches by a yellowish, stiff, plastic clay. Chert fragments are usually present in the soil and subsoil and in places are scattered over the surface.

As mapped the type includes areas in which the subsoil differs little from the subsoil of the Union silt loam. It also includes a few small flat or gently sloping areas in which gray mottling or a thin gray layer has developed between the soil and the heavy subsoil. Many areas of gravelly loam too small to be outlined separately have been included with the silt loam.

The heavy layer of the subsoil of this type locally contains more clay and is more plastic than in the southwest Missouri region.

Three areas of this type have been mapped in Cole County. Two of these lie in the vicinity of Russellville. The largest area extends from near Bass west and southwest to the county line north of Eugene. In all these areas there are patches of gravelly loam and there is more or less gravel in the material throughout.

The topography is undulating to gently rolling, parts of this type being more nearly level than any other upland type of the county. Nearly all of the land is well drained. Around the source of Clarks Fork, in the extreme southwestern part of the area covered by this soil, there are a few places that are not very well drained.

Before being brought under cultivation the type was nearly all prairie land. In places there is a growth of laurel oak and red oak, and along the small streams bur oak, elm and shellbark hickory. Practically all of the type is under cultivation, being used for corn, oats, wheat, hay and pasture. A considerable part is in bluegrass pasture. Very little clover is grown, timothy and redtop being the principal hay crops.

Wheat, when fertilized, yields about as well as on the Union or Memphis silt loam, and the yields of corn are slightly larger than on either. The type sells for $65 to $85 an acre.

This soil can be improved by using soy beans and cowpeas to add nitrogen. It can be sweetened and made more suitable for clover by applying ground limestone. The use of 200 to 300 pounds of acid phosphate on wheat gives good returns, and is an aid in getting stands of clover and grass.

MEMPHIS SILT LOAM.

The Memphis silt loam, as mapped in Cole County, consists of light-brown to brown mellow silt loam, drying to gray, grayish-brown, or light yellowish brown, and grading at about 6 to 10 inches into yellowish-brown silt loam, slightly heavier in texture, and this at about 10 to 16 inches into yellow or slightly brownish yellow moderately friable silty clay loam, which in places shows faint mottling with gray. At about 16 to 20 inches this grades into yellow or brownish-yellow moderately friable silty clay. At about 26 to 30 inches this silty clay layer becomes more silty, less clayey, and more friable, the texture ranging from silty clay to rather heavy silty clay loam. The substratum consists of a silt loam to silty clay loam, yellowish brown in color and friable in structure, with little or no gray mottling, especially where it is of silt loam texture.

Where conditions have been most favorable for leaching, the color of the soil when dry is light gray. This variation appears in flat or poorly drained areas and around the sources of the small streams. Small round iron concretions occur locally on the surface and through the soil and subsoil of such areas, and the mottlings in soil and subsoil are more pronounced. Such imperfectly drained areas really represent inclusions of another soil type, too small to map. In a few places the surface soil is a coarse silt or very fine sandy loam, and in some a very fine sand appears in the subsoil. As mapped the type includes areas having lenses of fine or very fine sand in the deep subsoil, as shown in exposures along the roadside. A small area of this sandy material is included in the State farm in the eastern part of the county.

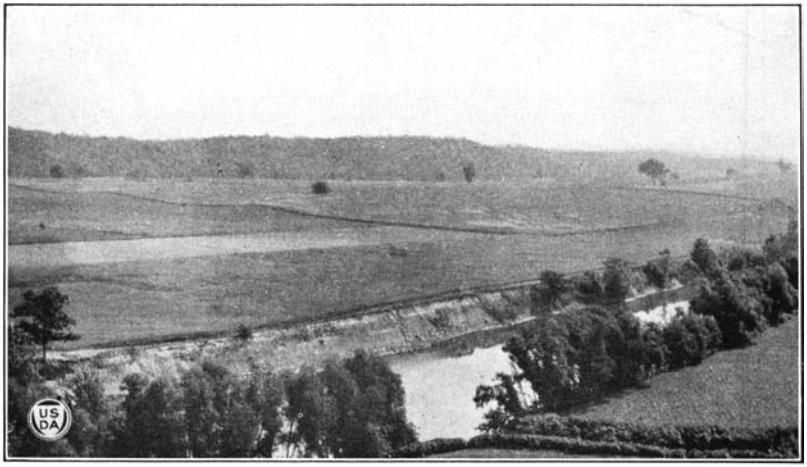

FIG. 1.—VIEW ACROSS A HORSESHOE BEND OF MOREAU CREEK, AS SEEN FROM THE BALD HILL ROAD.

In the foreground the stream flows to the left, then swings and flows to the right at the foot of the slope in the distance. The low bottom in the immediate foreground to right of the willows is Huntington silt loam. Across the stream at a slightly higher elevation is the low-terrace phase of the Robertsville silt loam. Above this, filling center of picture, is Robertsville silt loam. The higher ground in the bend at extreme right is Union silt loam, and the steep forest-covered slope in the distance is Union stony loam.

FIG. 2.—MEMPHIS SILT LOAM ON STATE FARM EAST OF JEFFERSON CITY.

This is seeded to Kentucky bluegrass and used for pasture for the dairy herd. The trees are walnut.

On the State farm much of the soil is a rich-brown mellow silt loam grading at an average depth of about 10 inches into yellowish-brown friable silt loam with a little gray mottling, this passing at about 20 inches into very friable yellowish-brown silty clay loam, with faint reddish cast, and at about 30 inches into yellowish-brown friable silty clay loam grading quickly into yellowish-brown friable silt loam with faint gray mottling.

In some places there is a very distinct compact layer in the lower subsoil, mottled with gray and containing much dark-colored concretionary material, this approximating the character of a hardpan. This feature, however, is of rare occurrence in this type, being much more frequent in the Union soil. This extreme development of the gray mottling and high content of concretionary material was noted in a small body on a flat ridge crest about 1 mile west of Jefferson City. Here the soil is a light-brown silt loam, passing at about 8 inches into mottled light-brown or yellowish-brown and gray silt loam, and this at 16 to 18 inches into mottled gray and yellowish-brown silty clay loam, which at about 24 inches passes into compact silty clay, mottled gray and yellow and containing considerable dark-colored concretionary material.

In many places, as that on the brink of the slope from the general upland level of the country to the Missouri River bottoms about 1 mile northwest of Cole Junction, the soil is intermediate between the typical and the very mottled variation described above. In such places the soil is a brown silt loam having a floury feel and grading at about 8 inches into yellowish-brown silt loam, and this at about 15 inches into yellowish-brown silty clay loam. Below this at about 18 inches, appears a yellowish-brown silty clay irregularly mottled with gray and containing some dark-colored concretionary material in the lower part of the 3-foot section. The material of this lower layer is a little less silty and more friable than the upper part of the silty clay stratum. The substratum generally consists of yellowish-brown friable silt loam to heavy silt loam or silty clay loam.

The underlying bedrock is reached on the smoother upland areas at depths ranging from about 6 to 12 feet. On the slopes the loess deposit thins out, and the soil grades in many places into the Union stony loam, and some areas contain cherty or dolomitic limestone material in the lower part of the 3-foot section.

On many slopes the soil is thinner, and the silty clay loam of the upper subsoil is frequently plowed up in small patches, giving freshly plowed areas a mixed yellowish-brown and brown or grayish color.

The loess deposit giving rise to the Memphis silt loam in Cole County has a maximum depth of not over 30 feet, and the greater part of it ranges in depth from 3 to 10 feet. It overlies the materials forming the Union silt loam and stony loam, and these protrude through the thin loess covering in many places. This is shown in Jefferson City, where many of the street cuts extend below the loess and expose the Jefferson City limestone. In a few places near the edge of the river bluffs the loess rests upon glacial till. One such area of considerable extent lies north of the State highway, immediately west of Jefferson City and east of the Cole Junction road.

The Memphis silt loam of this county is much thinner than the related Knox silt loam in the western part of the State, and it is also noncalcareous in the substratum, owing to the excessive leaching it has undergone. It is believed to have originally been much more extensive than at present and also deeper, and to have been reduced in both extent and depth by erosion.

The type so closely resembles the Union soils to the south of it that any boundary separating them must necessarily be somewhat arbitrary. The principal differences, as noted in passing from one to the other, are as follows: The topography of the Memphis silt loam, although quite as uneven as that of the country farther south, has a slightly more rounded appearance with fewer exposures of the underlying rock beds; the forest growth has a higher percentage of walnut, sugar maple, white oak, and pawpaw; the stand and growth of bluegrass is better; red clover seems to be more abundant and to make a better growth; there are more fields of alfalfa; and all crops seem to be slightly better than on the soils farther from the river. These differences are generally recognized throughout the county and are reflected in the slightly better improvements and higher prices of the land.

The Memphis silt loam occupies a belt approximately 2 miles wide across the north end of the county. A number of small isolated areas, in which the soil appears to be more nearly loessial than residual, have been mapped in the northwestern part of the county. In many other areas the influence of the loess covering has undoubtedly resulted in more productive soils, such as the one at Wardsville, in the eastern part of the county. Areas of this kind usually occur along the tops of the divides, where the material has been least subject to erosion.

Practically all of this type is hilly, and over much of it the slopes are as steep as can well be cultivated. Surface drainage is good to excessive, and the underdrainage is good, especially where the loess deposit is of considerable depth. Small, nearly flat, basinlike areas around the heads of small streams have poor underdrainage.

Owing to the steepness of the slopes and character of the soil, this type washes badly, so that in many places the subsoil is exposed. It has a pronounced tendency to gully, and when deep gullies are once established they are very difficult to check.

This type was originally forested with large white oak, hard maple, elm, walnut, and other hardwood trees. Practically all of it is now under cultivation. The principal crops are wheat, clover, corn, alfalfa, potatoes, bluegrass, and fruit. (Pl. XXVI, fig. 2.) Corn yields 30 to 50 bushels, wheat 12 to 20 bushels, and potatoes 50 to 100 bushels per acre.

Several dairy herds are kept on this type of soil, and there are also a few stock farms. The manure produced is usually applied to the land to be planted to corn or to the thin places in the wheat fields or pastures. Commercial fertilizers are used to some extent, principally on wheat, which receives 100 to 150 pounds of complete fertilizer or of treated or raw rock phosphate.

Land in which this is the principal soil type ranges in price from $75 to $150 an acre.

This soil has suffered from continuous cropping to corn and wheat and from erosion. It should be used to a greater extent for clover and for pasture and should receive, where practicable, more manure. Erosion should be controlled more effectively by seeding the gullies and drainage ways with redtop or some other grass, and checking the spread of gullies by building dams across them, filling with brush and straw, and by planting trees, black locust probably being the best for this purpose. Much of the type, owing to steepness of slope, should be used for pasture exclusively. This is the best upland soil for alfalfa in the county and is also well suited to apples and small fruits. It is used successfully in some parts of the State for growing tobacco.

ROBERTSVILLE SILT LOAM.

The Robertsville silt loam is a light-brown to gray silt loam, grading at about 5 inches into a light-gray to almost white silt loam, with yellowish and brown mottlings, which extends to a depth of 18 to 22 inches, where it is underlain by a light-gray to pale-yellow, tough, plastic clay. On the surface and distributed through the soil and subsoil in varying quantities are small round concretions, known locally as "buckshot." Below 24 to 28 inches the subsoil becomes more friable and is usually heavily mottled with brown and dark brown.

The character of the subsoil varies considerably throughout the type. Where the terraces are low and well drained the heavy layer of the subsoil is not so well developed or may be wanting entirely. Where the terraces are flat and poorly drained the subsoil is heavy and lies relatively near the surface. In places, as on the low terrace near Hubers Ferry, the subsoil consists of pale-yellow or pale yellowish gray, very tough, impervious, heavy clay, with little or no mottling. In some places the heavy clay does not come within the 3-foot section, as along North Moreau Creek near Lohman. Here the soil is a grayish-brown silt loam with light-gray mottling, passing quickly into almost white silt loam with a little pale-yellow mottling, underlain at about 20 inches by mottled light-gray and yellow or brownish-yellow silty clay loam containing some concretionary material, compact in places, but readily crushing between the fingers. This compact layer here extends to 36 inches or more without reaching heavy clay.

In many places, especially on the areas which reach down into the bends of Moreau Creek, this type occupies long slopes rather than terraces, and the soil is at least partly colluvial and partly residual. On a few low, nearly level slopes the surface soil is dark gray to a depth of a few inches. Around the margin of the Osage Valley many narrow high benches are found at the foot of the hill slope. The outer edge of these is marked by a distinct drop, but the opposite side grades into the hill slope so imperceptibly that it is difficult to determine which is terrace and which is upland. In other places, around the heads of small streams, or near the junction of a small stream with a larger one, areas of this type of soil have been developed, although not well-defined terraces.

The Robertsville silt loam is mapped in numerous areas along the outer edge of the valleys of the Osage River and Moreau Creek.

The surface is level or gently sloping. Surface drainage of parts of the type is good, but some of the areas are too flat to drain well naturally. They lie above overflow, but are often wet, on account of the run-off from the adjacent slopes. Underdrainage of the type as a whole is poor.

The greater part of the type is under cultivation, being used for wheat, corn, and pasture. The forest growth consists largely of water oak and post oak. The yields of corn are not so good as on the low-terrace phase, and the type is not well suited to clover, although some is grown on it. Corn yields 15 to 40 bushels, and wheat 10 to 16 bushels per acre.

This land can be improved to some extent by improving the drainage with open ditches. Applications of ground limestone would probably be beneficial, especially for clover. Alsike clover will be found more satisfactory than red clover.

Robertsville silt loam, low-terrace phase.—The Robertsville silt loam, low-terrace phase, is a light-brown to grayish-brown or light-gray silt loam, the gray increasing with depth and predominating below 5 or 6 inches. Below about 12 inches the material is a light-gray or light bluish gray to ashy-gray friable silty clay, which passes at about 20 to 24 inches into light bluish gray or ashy-gray plastic silty clay, mottled with pale yellow, and containing brown and dark-brown concretionary material. Small round concretions, locally called "buckshot," dark brown to black in color, are found on the surface and throughout the soil and subsoil, and there is also more or less mottling throughout.

This soil, as mapped in this county, occurs mainly on high first bottoms or low terraces, and very little of it is in low first bottoms, where it would be subject to frequent overflow. Some of it is flooded, if at all, only during very high stages of the streams. The areas occupying the higher positions appear to have the more impervious subsoil, and in this respect are more nearly like the typical Robertsville silt loam.

The phase consists largely of material washed from the adjacent residual soils, carried down and redeposited in the stream valleys. Extensive areas are found along the Osage River and Moreau Creek and smaller areas along the lesser streams of the county.

It has a nearly level surface, although in places in the Osage River bottom it occurs on low ridges. It is generally separated from the adjacent Huntington soils by a distinct drop or step, varying in height from 2 or 3 feet to 10 feet or more. It also is separated from the higher typical soil by a slope, usually 10 feet or more in height. Surface drainage is not very good, and underdrainage is restricted by the heavy subsoil.

The native vegetation consists of post oak, bur oak, water oak, and where the subsoil is not very heavy, of a wide range of trees, including white oak, ash, hickory, and elm.

Probably 75 per cent of this phase is under cultivation. Wheat is the leading crop, but corn, oats, redtop, timothy, and clover are also grown. Wheat yields fairly well. The soil is not as well suited for corn or clover as the Huntington silt loam. Part of the phase is in bluegrass pasture.

Land of this phase has a lower value than that of the Huntington silt loam, but little of it is for sale.

This soil can be improved in many places by laying tile drains or digging ditches. Alsike clover should be used in imperfectly drained fields, where it has been found difficult to grow red clover. Cowpeas and soy beans can be grown on this soil to good advantage.

BAGNELL SILT LOAM.

The Bagnell silt loam is a dark-brown to almost black mellow silt loam, grading at 4 to 6 inches into black silt loam, which passes at about 20 inches into grayish or bluish-black clay. In places the covering of silt above the clay subsoil is only 6 to 10 inches deep, and in other places the deep subsoil is a clay loam or silty clay loam.

The type is not extensive, the largest area being in the old valley of Moreau Creek west of Osage City. A number of smaller areas occur around the outer edge of the large valleys where there has been seepage from the neighboring hills into the valley, on long slopes which receive seepage from the limestone bluffs, or where a small stream enters a larger valley. Some areas too small to be shown have been included with the soils by which they are surrounded.

The principal part of this type is nearly level, but fairly well drained. Some areas need better drainage.

The greater part of the type is under cultivation, but on account of its small extent it is not an important type. It was originally in forest consisting of white oak, elm, walnut, and a variety of other trees. It is used for corn, wheat, clover, and alfalfa, for which it is well suited, giving yields almost equal to the Huntington silt loam.

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

Mechanical analyses of Bagnell 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.*
345225	Soil	0.0	0.0	1.0	1.3	27.0	56.4	14.3
345226	Subsoil	.0	.9	.6	3.9	18.2	55.0	21.3

BAGNELL CLAY.

The surface soil of the Bagnell clay is a very dark brown to black silty clay or silty clay loam grading at 3 or 4 inches into black silty clay. At a depth of about 10 inches this is underlain by dark bluish gray plastic clay with a slight mottling of yellow.

A small area of this type occupies a part of the abandoned valley of Moreau Creek east and west of Osage City. Smaller areas are found in the present valley of Moreau Creek. Two of them on the North Moreau near Lohman have been outlined, but a few smaller ones have been included with other types.

As mapped the type includes some small areas of Dunning clay occurring in the bottoms of the Osage River between the lock and Osage City. The Dunning clay is a dark-gray or very dark brown to black silty clay. Below 10 to 12 inches it becomes slightly lighter in color, but retains its tenacious, waxy structure to a depth of 3 feet or more. Upon drying it cracks and crumbles; when wet it is very sticky. Locally, the type is spoken of as "gumbo" land.

The Bagnell clay is difficult to plow and cultivate, but produces good crops of corn and wheat under favorable conditions.

Below are given the results of mechanical analyses of samples of the soil, subsurface, and subsoil of the Bagnell clay:

Mechanical analyses of Bagnell 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.*
345222	Soil	0.0	1.7	1.1	5.0	7.4	49.4	35.4
345223	Subsurface	.0	3.7	3.9	9.2	4.0	37.2	42.0
345224	Subsoil	.0	3.2	5.8	15.7	4.0	25.0	46.2

ELK SILT LOAM.

The Elk silt loam is a brown to light-brown mellow silt loam, grading at about 10 to 12 inches into a slightly lighter brown silt loam, and at about 18 inches into yellowish-brown silt loam or silty clay loam with some faint gray mottling. The lower subsoil is usually heavier than the soil and upper subsoil, but in some places it is a loam or sandy loam. A reddish colored material appears in the subsoil at some places, such areas representing an approach toward the Cumberland soils, mapped elsewhere on terraces of streams in limestone country.

A few small areas of this type have been developed along the abandoned valley of Moreau Creek and a few others near the Missouri River Valley in the western part of the county. The soil of these areas is to a considerable extent material eroded from adjacent loess-covered areas.

The type is nearly level, but well drained. It is practically all under cultivation, being well suited to all crops of the area. The yields are good, but on account of its small extent the type is not important.

HUNTINGTON SILT LOAM.

The Huntington silt loam is a brown to dark-brown mellow silt loam grading at about 12 to 15 inches into a slightly lighter brown or yellowish-brown silt loam, usually heavier than the soil, the texture ranging to silty clay loam. This layer may extend without change to a depth of 3 feet, but in many places at depths of 30 inches or less is underlain by loam or gravelly loam.

This type, as mapped, shows a number of variations in color and texture. It includes many small areas of sandy loam or loam, which occur principally as long, narrow strips near the stream channels and as slightly higher delta areas near the entrance of small streams into the main valleys. In the upper valley of Clarks Fork considerable areas carry enough medium and coarse sand to give the soil a distinctly loamy texture. Similar areas lie along many of the smaller streams which drain the southern part of the county, and in some of these the soil is a gravelly loam.

In much of the type there is more or less gray mottling and in places a distinct gray layer appears in the upper part of the subsoil. The type as mapped also includes numerous small areas of light-gray soil, either in low, poorly drained places or on benches slightly higher

than the main valley. Such areas, if of sufficient extent to be separated, would be mapped as Holly silt loam. In a number of places, especially in the southern parts of the county, small areas of dark-brown or almost black soil along the outer edges of the valleys have been included with this type. Such areas belong to the Dunning series, but are not of sufficient extent to be separated. The type also includes, especially in the smaller valleys, considerable areas lying at the foot of the slopes, in which the materials represent wash from the higher lying lands; i. e., are colluvial rather than alluvial deposits.

The Huntington silt loam occupies all or part of the first bottoms of the small streams, a narrow strip of low bottom along Moreau Creek, and several areas in the valley of the Osage River. It is level or nearly so. Much of it is subject to overflow at times, but at ordinary stages of water it is well drained.

This type is third in extent in the county, covers 8.8 per cent of the total area of the county, and is the most extensive of the alluvial soils. It has a wide distribution, nearly every farm containing some bottom land of this kind. Though originally heavily forested with white oak, elm, ash, sycamore, walnut, maple, and numerous other hardwood species, the greater part has been cleared and placed in cultivation. It is used more extensively for corn than for any other crop, but is also used for wheat, clover, and alfalfa, and in fact all crops of the region. Some excellent fields of alfalfa were noted in the valley of the Moreau. Corn yields 30 to 50 bushels and wheat 12 to 25 bushels per acre.

Farms having a considerable acreage of this type sell at prices ranging from $60 to $80 an acre. Much of this land is not for sale at any price. The type is better supplied with organic matter than most other soils of the area. It can be improved by growing more clover, by straightening the channels of the streams and otherwise improving the drainage, and by applying lime on the parts that are acid.

Huntington silt loam, heavy-subsoil phase.—The Huntington silt loam, heavy-subsoil phase, is a brown to rather dark brown mellow silt loam, grading at about 8 to 12 inches into lighter brown friable silty clay loam, which extends to depths of 3 feet or more or passes into light-brown or yellowish-brown friable silty clay above that depth. Typically there is little or no gray mottling, but in some flats and depressions of imperfect drainage a little mottling appears in the subsoil.

As mapped the type varies somewhat in texture. The soil ranges to the texture of loam or fine sandy loam near the Osage River bank and on low, narrow ridges, and a heavy silt loam or a silty clay loam is developed in some of the depressions farther from the stream.

The heavy-subsoil phase of the Huntington silt loam extends as a strip 20 to 60 rods wide along much of the course of the Osage River. It lies in the first bottom, usually being separated from the second bottom by an abrupt rise of 6 to 15 feet. It is nearly level, but includes some low narrow ridges and shallow depressions.

Practically all of the phase is subject to overflow, and serious damage to crops occasionally occurs. Except during overflows, the greater part is well drained.

The greater part of this phase is used in the production of corn, which yields from 40 to 65 bushels per acre, and sometimes even more. It is also used for wheat and clover and to some extent for alfalfa. It is practically all under cultivation and nearly all in a high state of productiveness. It is usually held in connection with adjacent terrace and upland areas and little of it is for sale.

Practically all of this phase lies at an elevation somewhat higher than the typical Huntington silt loam. This difference of elevation may vary from only a foot to several feet. The soil represents a transitional stage between the brown first-bottom soil with little or no mottling and no concentration of clay in the subsoil, and the light-gray, heavily mottled terrace soils with a compact almost impervious subsoil layer.

SARPY VERY FINE SANDY LOAM.

The Sarpy very fine sandy loam is a brown to light-brown very fine sand, grading at variable depths into yellowish-brown, light, very fine sandy loam, which passes into yellowish-brown to pale-yellow fine sand or very fine sand. Usually thin layers of brown silt loam or silty clay loam are interstratified at various depths with the more sandy, lighter colored material. On low swells or ridges, associated with slight depressions and paralleling the general direction of the river, the soil is very light in texture, being in many places a very fine sand. In the depressions it is often heavier than typical, being a light or medium silt loam. There is also a gradation in texture from the recently deposited material next to the stream channel, which is in many places a very fine sand, to slightly heavier soil farther back from the river. On the point of land extending between the Missouri and Osage Rivers near their junction the greater part of the type is very light, being but little heavier than a very fine sand. Small flakes of mica are commonly present in both soil and subsoil.

This type occurs in the Missouri River bottom in three areas, one near Osage City, another near Cole Junction, and a third in the northwestern part of the county above Marion. It is also an important type on Popes Island.

The surface is nearly level, but is marked here and there by low swells or ridges, 3 or 4 feet higher than the adjacent land, and intervening shallow depressions. Practically all the type is subject to overflow during high stages of the river, and some parts are flooded when the river is only slightly higher than normal. Between overflows the surface drainage of the greater part of it is good, and the type has no heavy layer to restrict underdrainage.

Probably about two-thirds of the Sarpy very fine sandy loam is under cultivation. It was formerly in forest, consisting largely of cottonwood and willow, with some maple, ash, sycamore, elm, and walnut. The uncleared part is covered almost entirely with cottonwood or willow. Where the soil has been recently deposited the growth consists chiefly of small willows.

This type is used for corn, wheat, watermelons, and garden truck. It is well suited to watermelons, which are grown rather extensively for the local market. It is not as good for corn or wheat as the heavier members of the Sarpy series.

On account of danger from overflow, land of this type, where unprotected, is not held at very high prices. Where protected from overflow, as in the northwestern part of the county, it is valued at $75 to $100 an acre.

The land is subject to overflow and the supply of organic matter is maintained by deposits left by the floods. Where protected from overflow, the supply must be kept up by applying manure or by growing legumes and other green-manure crops, otherwise this light soil will soon deteriorate.

SARPY SILT LOAM.

The Sarpy silt loam consists of an upper layer of brown to light grayish brown very fine sandy loam to silt loam, 3 or 4 inches deep; a second layer of brown silt loam which normally becomes heavier with increasing depth to 15 to 18 inches; a third layer of silty clay loam or silty clay of the same or slightly darker brown color, extending to 24 to 30 inches; and a fourth layer of lighter textured material, commonly a very fine sandy loam or light silt loam, and in places a very fine sand. In some areas the light-textured deep subsoil layer is not reached within the 3-foot section. Thin layers of very light fine sandy material or of heavy dark-colored silt or clay may be found at any depth in the soil or subsoil. The surface soil is rather uneven in texture, the low swells and ridges usually being lighter and the depressions heavier than typical.

The Sarpy silt loam has been formed by overflow from the Missouri River. It covers about half of the levee district near Marion and about the same proportions of Popes Island and of the river bottom at Cole Junction. East of the State farm, near Osage City, a small area which is not typical has been included.

The type is used principally for corn and to a less extent for wheat, clover, and alfalfa. It is a strong soil, more productive than either the lighter textured very fine sandy loam or the heavier clay. Corn yields from 40 to 60 bushels per acre, and larger yields are sometimes obtained.

The principal needs are protection from overflow, good farming with reasonable crop rotation, and in some places improved drainage. In the levee district near Marion the land is valued at about $75 to $80 an acre. Where unprotected its value is considerably lower.

SARPY CLAY.

The soil of the Sarpy clay is a strong brown silty clay grading at 15 to 24 inches into a brown friable silty clay loam, which passes into a silt loam or very fine sandy loam. Thin layers of soil of almost any texture may be found in the subsoil, but in places the light-textured subsoil is not reached within the 3-foot section. The greater part of the type, except where protected by levee, is subject to overflow. A small area in the extreme northwestern part of the county, lying several feet above the highest stages of the river, has been included with this type. Here the subsoil is a bluish-gray sticky clay.

The type occurs in two areas—one near Marion, the other near Cole Junction. As a rule it occupies the lower part of the bottom land. It is used principally for growing corn and wheat. The soil is difficult to handle, and the yields are generally lower than on the Sarpy silt loam.

RIVERWASH.

Between Popes Island and the mainland there was, at the time this survey was made, a low flat overgrown in places with small willows, but subject to overflow when the river is slightly above the normal stage. At one place a dike has been constructed from the island to the mainland, and the old channel is well filled with logs and drift. This area, which will doubtless in time be entirely filled, has been mapped as Riverwash.

SUMMARY.

Cole County lies near the center of the State, immediately south of the Missouri River. Its southern part extends well into the Ozark border.

The greater part of the county is undulating, rolling, or broken upland, a considerable part of which is nontillable, either because too rough or too stony. The rest of the county consists of terrace and bottom lands. The bottom lands along the Missouri River are not extensive, but along the Osage River, Moreau Creek, and the numerous smaller streams there are considerable areas. These are practically all under cultivation.

The Missouri and lower Osage flood plains are somewhat more than 500 feet above sea level. The main upland divides range in height from 750 to 850 feet, with a maximum height of 900 feet.

Nearly every part of the upland is well drained. The stream terraces or second bottoms are usually rather poorly drained on account of their level topography and compact subsoil, and most of the low or first bottoms are subject to occasional overflow.

Cole County has a population of 24,680. Jefferson City, the largest town, has a population of 14,490. The rest of the population is classed as rural. It is rather uniformly distributed, and the average density is 26.2 persons per square mile.

St. Louis is the leading outside market for this region. Jefferson City is the principal local market.

The agriculture consists of general farming and stock raising, combined with grain growing.

Wheat is the principal cash crop on most farms. All farmers grow corn, but the greater part of it is used in feeding work stock or in fattening cattle and hogs for market.

Clover is an important crop. It is grown for hay, for seed, and for keeping up the fertility of the soil. Other crops are oats, timothy, sorghum, and potatoes.

Farmers of the region know their soils and to a considerable extent adapt their crops to them. Farm equipment is in general good.

Commercial fertilizer is used to some extent, principally on wheat, but many farmers do not use fertilizer at all. Manure is carefully saved and applied to the fields. Only a few farmers practice liming.

About 83 per cent of the farms of Cole County are cultivated by the owners, who, with their families, do practically all the work.

Land prices are moderate. The price for the better grade of uplands is $60 to $75 an acre.

The upland soils of Cole County are residual, being derived principally from a magnesium limestone, the Jefferson City formation. Three series—the Union, Baxter, and Eldon series—have been recognized.

The Union soils have grayish to light-brown surface soils, a slightly darker brown heavy upper subsoil, and a mottled gray, brown, or dark-brown, friable lower subsoil. The stony loam and the silt loam are both extensively developed, the silt loam being the most extensive type in the county. Practically all of the stony loam is in forest, and it is suited for the most part only to forestry and pasture. The silt loam is a good general farming soil.

The Baxter soils have reddish-gray to reddish-brown surface soils and a reddish-brown subsoil. Two types, the stony loam and the silty clay loam, are mapped in the county. The silty clay loam occurs in a few small isolated areas and is not important. The stony loam is more extensive, covering considerable areas in the southern part of the county. This is mostly in forest, to which it is best adapted. The silt loam is best suited to wheat, clover, and grass.

The Eldon soils have dark-brown to black surface soils and a mottled gray, light-brown, or reddish-brown, heavy subsoil. Two types—the silt loam and gravelly loam—appear, though in rather small developments. The silt loam is well suited to general farming; the gravelly loam to forestry and pasture.

A narrow strip of upland on the northern side of the county is occupied by a wind-blown or loess soil, the Memphis silt loam. It has a light-brown or buff color and a smooth velvety texture. It is not only suited for the growing of all crops of the county, but is especially adapted to alfalfa and fruit growing.

The Robertsville silt loam is a terrace or second-bottom type with a light ashy gray soil and a heavy almost impervious subsoil. The low-terrace phase of this type is a light-gray, almost white soil, which resembles the type, but occupies a lower position and is more productive. Clover does well on this land.

Other terrace types of small extent are the Elk silt loam, Bagnell silt loam, and Bagnell clay.

The brown first-bottom soil of the small streams is the Huntington silt loam. It is productive and suited to a wide range of crops, but some of it needs drainage and nearly all of it is subject to overflow. The corresponding brown soil of the Osage River bottoms has been derived partly from material washed from the black prairie soils farther west and has been correlated as a heavy-subsoil phase of the Huntington. It is used principally for corn and is productive, but is subject to overflow.

In the Missouri River bottoms the soils have a light-gray to dark-brown surface soil and a light-brown fine sandy loam or silt loam subsoil. These belong to the Sarpy series, which in Cole County is represented by three types—the very fine sandy loam, the silt loam, and the clay.

The Sarpy very fine sandy loam lies at the outer or river edge of the bottom and on the low swells and ridges. Much of it is too sandy to be productive. The better areas produce good crops of wheat, corn, and melons.

The Sarpy clay occupies low-lying poorly drained areas near the bluff and is wet and difficult to cultivate. It is a good corn and wheat soil.

The Sarpy silt loam lies between the other two types, is well drained except during stages of overflow, is easy to cultivate, and productive, being an excellent corn soil and giving good crops of wheat, alfalfa, and clover where properly drained.

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