SOIL SURVEY OF THE O'FALLON AREA, MISSOURI-ILLINOIS.

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LOCATION AND BOUNDARIES OF THE AREA.

The O'Fallon area lies in the form of a rectangle, with its southeast corner about 20 miles northwest of St. Louis. It is 28 miles long from east to west and 24 miles wide, containing 396,928 acres, or about 620 square miles, land surface. Geographically it lies between the parallels of 38° 40′ and 39° north latitude, and the meridians of 90° 30′ and 91° west longitude. The largest two rivers in the United States and a third of very considerable size flow through the eastern

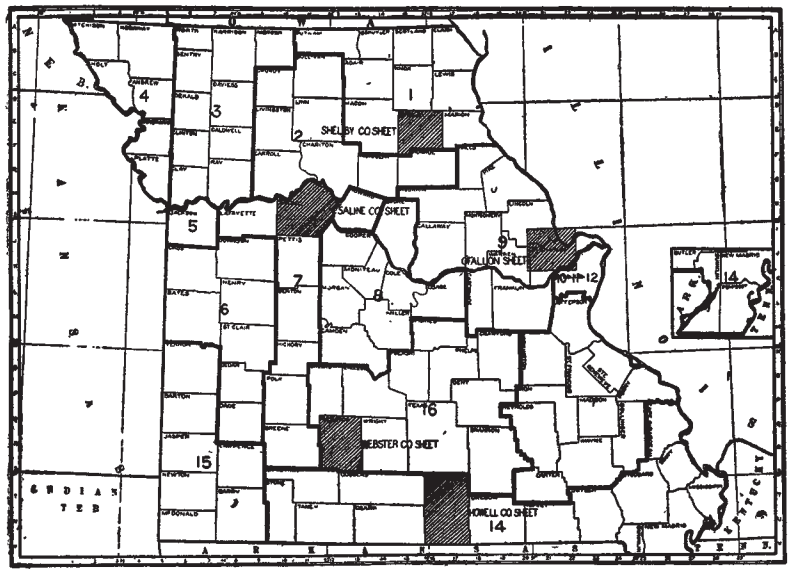

FIG. 34.—Sketch map showing the location of the O'Fallon area, Missouri-Illinois.

part of the area. About 68 square miles lying in Illinois, across the Mississippi River, forms the northeastern corner of the area. Through this part also flows the Illinois River. The Missouri River, entering the area from the south, takes a northeasterly course and soon leaves the area. All of these rivers unite a few miles east of the area. Kansas City lies almost due west, at a distance of 250 miles, and two direct lines of railroad connecting that city with St. Louis

pass through the area. The Wabash Railroad traverses the uplands a little south of the center, while the Missouri, Kansas and Texas Railroad follows the north bank of the Missouri River. Three miles farther south a third main line, the St. Louis, Kansas City and Colorado Railroad, crosses the southeast corner of the area. The St. Louis, Keokuk and Northwestern follows the Mississippi bottom north, and a branch extends southeast from Old Monroe, connecting with the Wabash at St. Peters. Beginning at Old Monroe and extending westward below Troy there has been constructed, during 1904, a branch of the Burlington system. This branch will form part of a through line between St. Louis and Kansas City.

Parts of six counties are included in the survey. These are St. Charles, Lincoln, Warren, and St. Louis, in Missouri, and Calhoun and Jersey, in Illinois. The greater part of the area lies in St. Charles and Lincoln counties. The largest towns in the area, in the order of their size, are Troy, Wentzville, O'Fallon, St. Peters, Winfield, New Melle, and Brussels, each having a population of less than 1,500. St. Charles, a town of several thousand population, is situated just off the eastern border. Troy, the county seat of Lincoln County, is on the St. Louis and Hannibal Railroad, which connects with the Wabash at Gilmore. No railroads touch the Illinois part of the area, but there is boat service on both the Illinois and Mississippi rivers.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

The present well-developed industrial system of the area had its beginning about three-quarters of a century ago. At that time the country was unoccupied, except for a few scattered white hunters who were associated with the earlier French settlement at St. Charles and with the American settlement made by the famous Daniel Boone below New Melle, just over the border of the survey. Forests covered most of the region, being found along all the streams and on the more broken country, while prairies occurred at a few points on the level upland divides, particularly in the vicinity of Wentzville, and were covered by the characteristic " prairie grass." Prairies also occurred on the Mississippi bottoms. On the hills oak, hickory, and walnut were the most abundant forest species, and in the bottoms elm, hackberry, sycamore, box elder, and maple.

Some permanent settlers, carrying a mixture of French blood, naturally came into the area by way of St. Charles, and through Boone's efforts settlers from Virginia and Maryland entered the western part, but of far greater importance was the German immigration, which became active about 1833. Descendants of those people now form the bulk of the population. It is noteworthy that the timbered land on the hills and in the bottoms was the first occupied

by the settlers, and that the prairies were the last to be brought under cultivation because they were thought to be of low productive power.

Grain farming after the methods of the times has been the chief agricultural industry since the first settlements were made, though the raising of live stock, first for home purposes and then for market, has occupied an important place. Lately there has been a tendency to increase the dairy output, a large part of which takes the form of milk and cream for the city market. Fruit has been grown to some extent from the very beginning, and has advanced to a position of some commercial importance. Old apple orchards, several acres in extent, are sometimes seen, being more numerous in the eastern than in the western part of the area. The marked success of some of these has caused very large plantings in recent years, some of which have come into bearing with satisfactory results. In Illinois especially and near St. Charles the planting of both apple and peach trees has been carried on very actively during the last two years, so that in a few years more the region will rank with the leading fruit producing sections in the States of Missouri and Illinois. In the southern part of the area large wine cellars have been in existence for forty years or more, and large vineyards are still maintained.

CLIMATE.

A fair idea of the climatic conditions in the area surveyed may be obtained from the following table, taken from the records of the Weather Bureau stations at St. Charles, St. Louis, and Warrenton, which shows the normal monthly and annual temperature and precipitation:

Normal monthly and annual temperature and precipitation.

Month.	St. Charles.		St. Louis.		Warrenton.	
	Temperature.	Precipitation.	Temperature.	Precipitation.	Temperature.	Precipitation.
	° *F.*	*Inches.*	° *F.*	*Inches.*	° *F.*	*Inches.*
January	31.0	2.06	30.5	2.18	29.8	2.26
February	31.4	3.07	35.1	2.78	29.8	2.63
March	42.5	3.16	43.1	3.49	41.1	3.81
April	55.9	3.19	56.2	3.79	55.6	3.71
May	64.2	4.29	65.8	4.58	65.2	5.04
June	74.0	4.36	75.2	5.08	73.8	4.87
July	77.8	3.35	78.8	3.76	77.8	3.57
August	76.2	2.71	76.8	3.50	76.8	2.32
September	68.8	2.55	69.4	3.12	68.5	3.34
October	57.7	2.30	57.5	2.89	55.7	2.38
November	44.1	2.92	43.6	3.10	42.3	2.76
December	35.0	2.18	35.6	2.81	32.6	2.54
Year	54.9	36.14	55.6	41.08	54.1	39.23

From these data it appears that about 57 per cent of the rainfall occurs during the six months of the growing season.

PHYSIOGRAPHY AND GEOLOGY.

The uplands exhibit a pleasing diversity of rolling and hilly topography, which in a few places becomes distinctly rugged. The Mississippi River receives directly probably 80 per cent of the drainage through its chief tributaries—the Cuivre River and Peruque and Dardenne creeks. The elevation of the area ranges from a little more than 400 feet along the rivers to about 850 feet at the highest point on the uplands in the southwestern part, 6 miles west of New Melle. Hence the general slope is eastward. Callaway Creek is the only important stream flowing into the Missouri River. The central part of the area is the most level and consists of broad divides which lead by long, graceful slopes to the streams. The country around Wentzville, Josephville, and Dardenne and that northwest of New Melle is of that type, but none of the region is at all flat. Frequently the streams, even in the section just mentioned, are bordered by abrupt bluffs from 60 to 100 feet in height, while toward the northern, western, and southern borders of the area the country becomes more hilly, and around the heads of Big and McCoy creeks in the west central part, and along Callaway Creek and the Missouri River in the southern part, the surface is very broken. The drainage system, in general, is of the ramifying type and the valleys of the main streams and their tributaries are lined by steep limestone bluffs, sometimes 200 feet in height. All the smaller streams wind through narrow areas of flat bottom land, the material of which has been carried from the surrounding hills. Along Cuivre River these bottoms are nearly a mile in width. All except the larger streams are without running water during most of the year and serve chiefly to conduct the water during rains, when it runs off very rapidly and is very destructive to the stream banks. The water sometimes reaches a height sufficient to overflow the bottom lands and damage crops. During times of heavy rainfall great gullies form in the steeper hillsides, which hinder cultivation of the fields and greatly decrease their productiveness.

The upland country on the Illinois side consists of a strip about 4 miles wide that extends southeast between the bottom land of the Illinois River and the main channel of the Mississippi River. The latter stream, during most of its course, washes against a steep bank from 100 to 250 feet in height, the lower half of which is composed of limestone. The drainage is by several short streams toward the east. The surface is very hilly throughout, but, unlike most of the part of the area in Missouri, the slopes do not contain outcropping rocks. In the vicinity of Beechville there is much of the kettle

hole topography, which is found only infrequently in other parts of the area.

The large river bottoms occupy about 165 square miles of the area. Along the Mississippi they are from 4½ to 6 miles wide; along the Illinois the width is from 2 to 4 miles, and along the Missouri River the width is a little over 3 miles. These constitute the inner gorge of the rivers and are bounded by steep walls, for the most part founded on and composed of limestone. At some time in the past the main streams meandered over all of these bottoms, and their former position is indicated by the numerous winding, shallow depressions, or old slough ways. All of these contain water at certain seasons of the year, and some of them are constantly filled, forming the horseshoe lakes and side sloughs. The surface in general is flat, slightly modified by depressions and ridges. The part near the bluffs is usually slightly lower than the stream bank. Along the Mississippi River this has caused the formation of large prairie areas, which are covered by tall, wiry grass and sedge. During the greater part of the year these lands are covered by a few inches of mud-laden water.

In the Mississippi and Missouri rivers appear a number of islands, several of which are a square mile or more in extent. These were formed first as sand bars, and when raised to a sufficient height they received only the finer particles during high waters. The upstream portion and the shores received the coarser and larger deposits, while the lower interior received the finer particles from the more quiet water.

The two geological formations most important in their relation to soils belong to the Quaternary period, and consist of a thick mantle of loess over all the hills, and the later alluvium in the bottoms. From a depth of 30 or 40 feet in the eastern part of the area, the loess thins to an average depth of about 4 feet on the western border. With this thinning there is an increase in the clay content and a decrease in the characteristic properties of true loess. Typical loess is composed of two-thirds silt, and is rich in lime carbonate and iron compounds. The former of these is present here only in very small amounts, especially in the heavier material on the western side. No tubes or nodules of importance were observed during the progress of the survey. In the heavier material of the western part of the area small iron concretions of buckshot size frequently occur. In fact, "buckshot land" is a term locally applied to such soil. The thinner material exhibits many of the qualities of clay in its cleavage structure. It breaks into small angular fragments that are very hard when dry, as are also the dry walls of the material. In the eastern part of the area and in Illinois the clayey stratum is less thick and heavy, and grades downward into pure mealy silt of massive struc-

ture, while a considerable part of the lower material is of a light-gray color and frequently grades downward into fine sand. At several points near the Mississippi River sections 40 feet in depth were observed, in which the clayey surface material graded downward through silt and fine sand to medium sand at a depth of 15 feet, below which the material was of finer texture and more distinctly stratified, until at the base occurred a dense blue mud. The loess is by far the most important soil-forming material in the area and has given rise to all the upland silt loam types, and, a little less directly, to several of the lowland types.

As a rule, the loess rests directly upon rock ledges or on the residual product of such rock, but it is probable that some glacial till intervenes in a few places between the silt mantle and the bed rock. Till was not observed except at one point on Sam Creek, 5 miles southwest of Wentzville, but glacial bowlders are frequently seen in the western part of the area, and at points sufficiently high to preclude their having been carried there in the present drainage.

The rocks exposed at the surface consist almost entirely of limestone of every type of bedding, together with sandstone and some mud rocks. In the eastern part the Coal Measures are represented, and coal has been mined at a number of points. The seams, however, are at present not profitable for working. Passing westward, increasingly older rocks are exposed through the lower Coal Measures and the St. Louis and Trenton limestones, down probably into the magnesian series of the Paleozoic age. The accuracy of these correlations, however, can not be verified, because no systematic study of the detailed geology of the region has been made. It is sufficient for our purpose to know that rock formations of the kind enumerated do occur. These rocks are represented in the soils only on the steepest slopes, where fragments of them occur at the surface, mixed with some residual material and with silt washed from the loess, and are all included in one type.

The alluvium consists of the material deposited by the streams at flood times in the wide bottoms or flood plains and as bars and islands in the main stream. It comprises a variety of materials arising from the various currents and conditions of deposit, and ranges from coarse sand to very heavy, tenacious clay. The material nearest the stream, and hence at times of overflow in the swiftest current, is of the coarser texture.

The three bottoms exhibit individual peculiarities in the materials composing them. In the Illinois bottom the material contains very little sand, and the position of the stream is quite stable; along the Mississippi the sand is distinctly noticeable near the stream, though largely masked by finer grades of material; but along the Missouri River sand is abundant at the surface in many places and underlies

all the heavy material at a short distance below the surface. The current of the latter river is much the swiftest of the three, and tends to change the course of the stream rapidly by eroding away the banks. This process is more rapid during rising water and an inshore wind. The basal fine sand is quickly washed out and the upper material drops into the river in great blocks. Hundreds of acres of excellent farming land have been removed in this manner, and 15 or 20 acres are sometimes taken from a single curve in one season.

With the exception of a few very high points in the Mississippi bottom near Portage des Sioux, all of these lowlands are subject to overflow by the high waters of the rivers. Sometimes all the islands are covered, most of them are at frequent intervals, and in June, 1903, the overflow water reached a depth of 10 feet at many points. During most seasons, however, no such great depth is attained, and in two or three years out of five a full crop is insured on most of the cultivable bottom land.

SOILS.

The soils of the area have been divided into ten types, of which four occur exclusively on the uplands, two are developed in the small valleys, and the remainder occur in the bottoms of the large rivers. The increase in the proportion of clay in the loess formation from the eastern margin of the area to the western margin has been made the basis for the division of the silty material into different types. The line of division is an arbitrary one and does not indicate that there is any sudden change in the character of the material, but it is intended rather to separate the more clayey part, the western half, from the less clayey part, the eastern half. This division corresponds in general to the crop interests in the two parts. Fruit has been found to succeed best on the more silty soil, and the distinctly clayey portion is devoted more exclusively to cereals and the grasses.

The names and extent of the several types are given in tabular form below:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Marion silt loam	175,552	44.2	Yazoo loam	16,640	4.3
Waverly silt loam	57,088	14.4	Memphis silt loam	5,376	1.3
Miami silt loam	54,656	13.8	Miami fine sand	1,728	.4
Yazoo clay	31,936	8.0	Sioux sandy loam	320	.1
Rough stony land	30,208	7.6	Total	396,928	
Waverly clay loam	23,424	5.9			

MIAMI SILT LOAM.

The soil of the Miami silt loam is a brown or gray silt loam with an average depth of about 14 inches. There is some variation in the texture of the material in different parts of the area. As already

pointed out, there is a gradual increase in the content of clay as the areas extend toward the west, and this makes the soil as found south and west of the Mississippi River somewhat heavier than that developed east of the river. In the area between the Illinois River and the Mississippi River the soil is relatively coarse, more friable, and contains a higher percentage of very fine sand. The variation in the color of the surface soil is due to erosion, the lighter tones occurring on the slopes, where the wash is greatest.

The subsoil is a yellow or light-brown clayey silt loam, showing the same peculiarity of increasing clay content from east to west. The material is seemingly massive, but has a coarse cleavage structure, with fine sand distributed along the joint planes. When containing a moderate quantity of moisture it breaks down into a friable loam, but when dry it is rather hard. This coarse, flaky characteristic of the subsoil is most pronounced east of the Mississippi River. In the eastern areas, beneath this clayey stratum, the material becomes nearly a pure silt, but in the western limits of the type this difference in the deeper subsoil is not so apparent.

Where the loess deposit is thickest and the slopes are steep, the erosion has been so great in many places that the surface clayey stratum has been removed, and the subsoil is composed of the purer silty material. This is the character of the type on the steep slopes in the Illinois areas, and the resulting soil has a very different crop value from that of the steep slopes of the Marion silt loam, derived from the most clayey phase of the loess deposits.

The Miami silt loam includes that part of the loess formation in the eastern half of the area. It occurs in three bodies, separated from one another by the Illinois and Mississippi rivers, and the several bodies are cut by narrow strips of valley soils and by Rough stony land on steep hillsides. The western margin of the type has a general north and south direction and lies from one to several miles west of the rim of bluffs on the western side of the Mississippi River. It is an irregular line, in large degree arbitrarily placed, as already mentioned, and is drawn along streams over a large part of its course. The greater part of the type lies in Missouri. The Illinois area, which is divided into two bodies by the Illinois River, contains only about 68 square miles.

All of the Miami silt loam is rolling or hilly, the elevation ranging from 50 to 250 feet above the level of the large river bottoms. Small drainage streams, which have their sources in the upland, traverse the type, and adjacent to these the slope is frequently quite steep. The hilliest area lies east of the Illinois River, and consists of two narrow ridges. A rocky outcrop separates these ridges into two levels, the lower of which, though very rolling, has rather more gentle slopes than the higher.

The drainage of this type is good. The surface slope is sufficient to prevent any considerable accumulation of water, and the porous character of the soil permits it to absorb moisture readily. Notwithstanding the latter quality, the steep hillsides in all parts of the type are subject to destructive washing during heavy rains, and deep gullies are formed that are a great hindrance to cultivation.

The native timber is more thrifty and consists of a greater number of species than on the Marion silt loam. There is less oak and more maple, basswood, boxelder, elm, hackberry, hickory, and walnut.

The fruit industry has its greatest development on this type of soil. In Illinois there is a large number of bearing apple orchards which have been profitable for a number of years. Along the bluffs of the Mississippi River in Missouri apples also form an important product. The uniform success of these old orchards has led to the planting of many hundreds of acres of young apple trees within the last two or three years, and while these have not come into bearing their condition indicates the peculiar adaptation of the soil to this fruit. Most of the orchards lie between the Mississippi and Illinois rivers. Peaches are also said to succeed well, but the lack of facilities for rapid transportation has prevented their being grown to any great extent. Late truck crops and berries do well. Large quantities of potatoes are grown, the yield ranging from 100 to 250 bushels per acre. The cereals, grass, and clover give good yields. Corn produces from 40 to 80 bushels, wheat 18 to 30, oats 35 to 50 bushels, and hay from 1½ to 2 tons per acre.

Most of the type is valued at from $40 to $80 an acre. Some very rough land overlooking the Missouri River and east of the Illinois River has a lower value, and some small areas may be had for less than $10 an acre, a price in part due to location as regards markets.

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

Mechanical analyses of Miami silt loan.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10830	4 miles W. of Brussels, Ill.	Brown silty loam, 0 to 18 inches.	0.0	0.2	0.2	0.5	14.0	76.4	8.5
10832	3 miles S. of Brussels, Ill.	Gray silty loam, 0 to 18 inches.	.1	.3	.2	.7	10.4	75.0	13.1
10831	Subsoil of 10830	Brown clayey silt, 18 to 36 inches.	.0	.2	.1	.3	12.1	66.9	19.8
10833	Subsoil of 10832	do	.0	.0	.1	.2	7.9	64.9	27.0

MARION SILT LOAM.

The soil of the Marion silt loam to a depth of from 10 to 15 inches is a dark colored to gray silt loam. The color varies with the proportion of organic matter present and is darker on the broad divides and lighter where the surface is more hilly and erosion has been active. The surface soil is also deeper and more friable on the more level areas than on the slopes.

The first 4 or 5 inches of the subsoil in the areas of darker soil is a light-brown silty clay, changing gradually to a more silty yellow material at a depth of 30 inches. In the rougher portions of the type the upper part of the subsoil is frequently a very fine sand and silt of a light-gray color, changing with depth, as in the former case, to light yellow. In general, the upper part of the subsoil is heaviest, i. e., contains the most clay, and there is a gradual increase in the proportion of silt with increase in depth.

In the western part of the Marion silt loam, and particularly where the surface is very rough, the soil over areas of a few square rods has been washed away and a heavy clay exposed at the surface. The difficulty experienced in cultivating these places has led the farmers to apply the term "hardpan" to them, and there are also other places where the subsoil is nearer the surface than is usual to which the same term is applied. The soil in a number of such areas was examined, but the material did not appear to contain perceptibly more clay than in adjoining areas where the hardpan character was absent. The high percentage of clay in the upper part of the subsoil causes it to become very dense when dry, and this is probably the only cause of its being so intractable. A characteristic of the subsoil is its granular structure, which is the finest in the upper part, the granules ranging in size here from less than a grain of wheat to flakes much larger in the lower part of the soil section. The granules are angular and when dry become very hard. They are the result of a complex arrangement of joint planes in the loess formation.

As might be inferred from the description of the loess given in the chapter on geology, the Marion silt loam is more clayey in the western part of the area than in its eastern limits. It also thins out from the east toward the west, and from the crest of the divides to the margin of the streams, where the inclination of the slope is greatly increased. From this condition arises the thinness of the soil in the latter position, where, over small areas, a flinty residual material occurs within 2 feet of the surface.

The soil of a large part of this type, particularly of the light-colored phase, contains a large quantity of small, rounded iron concretions the size of buckshot. They are less abundant in the subsoil,

and gradually diminish in number toward the east. The upper 20 inches of the subsoil is usually mottled with reddish brown, and in the western areas of the type the lower part of the section is frequently stained slightly red, probably by the underlying red residual clay.

None of the Marion silt loam is found in the eastern half of the area surveyed, but nearly all of the upland in the western half of the area is occupied by it. The surface is rolling and hilly, and may be separated into two topographic divisions. The first includes very rough, broken land adjacent to many of the streams, and the second the high, broad divides between the larger streams. The surface of these large divides is not level, but lies in long, graceful swells, some of which reach by a moderate slope to the streams.

There are six streams of considerable size crossing the part of the area occupied by this soil, all flowing in an easterly direction. Small tributaries flow into them from the north and south. The general contour of the country has been formed by long-continued erosion of calcareous rocks, and at some points deep gorges occur, while at others are found broad valleys. The roughest areas of the soil are found where deep, narrow gorges prevail. A few of the most important of these rougher areas are: North of Cuivre River, including nearly all of the country drained into Bobs Creek; along Indian Camp Creek, and Big Creek west of its union with the former, and around the heads of the tributaries of McCoy Creek west of Flint Hill, where the greater part of the type has this character of surface; and in the southwestern part of the area along Calloway Creek, Dardenne Creek, and Little Dardenne Creek. In general, the Marion silt loam of this character of topography is associated with Rough stony land. Along Peruque Creek between Gilmore and O'Fallon is also some very rough country.

The more important of the broad divides with gentle slopes are south and east of Troy; west of Highview; from Foristell to Wentzville, and from thence to the region around St. Paul by way of Gilmore and Josephville; and nearly all of the divide between Peruque and Dardenne creeks, and around the head of the latter creek to Cappeln. The soil with the rougher topography is in large part very difficult to cultivate because of the steep slopes, but the broad divides offer no hindrance to the use of ordinary farm machinery.

The drainage of this type of soil is not very good. On the contrary, east of Wentzville, east of Flinthill, and at many other points in the most level areas in the extreme western part of the area the drainage is decidedly poor. Even on the slopes the drainage very often is defective. This condition is due to the heavy and impervious character of the subsoil. Rain water sinks readily into the upper soil,

especially in the darker areas, and when the precipitation is heavy the subsoil becomes thoroughly saturated with moisture, which it gives up very slowly. The large amount of water retained by the subsoil and soil injures growing crops by drowning, and tends to severe heaving in winter. This can be plainly seen in wheat and grass fields in early spring. The tendency to retain water also makes the ground late for spring planting, by keeping the soil cold and by hindering cultivation. To correct this unfavorable condition of drainage tile drains are necessary. These should not be laid very deep; not over 2½ feet below the surface, nor should tile drains be confined to the more level areas, for they will be found of benefit even on decided slopes. Under the conditions existing in this type of soil, surface drainage, though helpful, is far from satisfactory.

As in the Miami silt loam, the surface of the steep slopes, particularly in the eastern part of the type where it contains most silt and is deepest, is washed badly by heavy rains, and once gullies are started their extension is difficult to prevent.

The origin of the soil from the weathering of the loess has already been noted.

The upland prairies, as they existed at the time of the settlement of the country, were formed of this type of soil. The largest areas were located around Wentzville and extended more or less continuously to St. Paul; and also on the divide south of Peruque Creek from the town of Dardenne westward. All were covered by prairie grass, and, though fringed by low shrubs, are said to have been free from tree sprouts.

There is a difference in the valuation of lands of this type, due, in part, to the surface features and the distance from shipping points. The remote rough land is worth from $5 to $20; the more level and better farming land from $30 to $60 an acre; and in some of the most favorable locations the value is even higher.

The type is well adapted to the production of grains, grasses, and leguminous forage crops, and the heavier areas make a better wheat than corn soil. It is admirably adapted to the production of the forage and pasture crops. The supply of organic matter, however, should be increased and maintained by the growth of leguminous crops and by the addition of any other available organic remains, and along with these potash and phosphate fertilizers would be helpful. Deep plowing in breaking the soil and shallow level cultivation are recommended for this type. All crops grow better on the dark-colored than on the light-colored soil. The latter can be greatly improved by the use of manures, deep plowing, and careful cultivation, and instances were seen where this part of the type had been made to give as good yields as the more level parts.

The crops grown are corn, wheat, oats, and hay. For hay, both

timothy and clover are used. Considerable difficulty has been experienced in recent years in getting a good stand and growth of clover. Bluegrass occupies the soil naturally on the lighter textured areas of the type, but its growth is slow and weak where the soil is light colored. It is, however, the principal pasture grass. On the dark loam soil the average yield of corn is about 35 bushels; of wheat, 18 bushels; of oats, 35 bushels, and of hay, from 1 to 1½ tons per acre. In the most favorable seasons the yields are much larger, corn yielding as much as 70 bushels, wheat 30 bushels, oats 50 bushels, and hay 2 to 2½ tons per acre. The yields in either case on the rougher areas are less than the figures given. Potatoes and late truck grow fairly well and small fruits make good returns. Tree fruits have not been grown to any great extent. A few old apple trees, nearly beyond their bearing stage, were observed. Within the last few years a good many apple and some peach trees have been planted near New Melle, Foristell, and Wentzville, and the growth of these trees has thus far been satisfactory. Plums will succeed better on this heavy soil than peaches or cherries.

The following table shows the results of mechanical analyses of typical samples of the Marion silt loam:

Mechanical analyses of Marion silt loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10842	2 miles NW. of O'Fallon.	Gray silty loam, 0 to 16 inches.	1.0	1.7	0.6	0.5	5.1	75.1	16.0
10965	3 miles S. of Wentzville.	Dark silty loam, 0 to 18 inches.	.5	2.5	1.1	.8	1.4	75.8	17.7
11239	½ mile E. of Wentzville.	Silty loam, 0 to 17 inches.	.6	2.1	1.2	1.2	1.6	74.3	18.3
10766	3 miles SW. of Winfield.	Gray silty loam, 0 to 17 inches.	.2	1.2	.7	1.1	5.8	70.8	20.0
11240	Subsoil of 11239	Silty clay, 17 to 36 inches.	Tr.	1.1	.7	1.2	1.2	62.1	33.4
10767	Subsoil of 10766	Brown silty clay, 17 to 36 inches.	.1	.4	.3	.6	3.6	59.1	35.9
10843	Subsoil of 10842	Stiff clay, 16 to 36 inches.	.3	1.1	.5	.8	3.1	58.2	36.1
10966	Subsoil of 10965	Clay, 18 to 36 inches	.4	1.0	.5	1.0	1.5	53.2	41.6

MEMPHIS SILT LOAM.

The soil of the Memphis silt loam, to an average depth of 16 inches, consists of a grayish-yellow silt loam of a loose, friable character that responds readily to cultivation. The color is the result of a consid-

erable accumulation of organic matter, together with small amounts of oxides of iron. The subsoil is a light-brown or yellow silt loam, soft and mealy in its upper part, but usually heavier and noticeably clayey at 36 inches below the surface. Much of the type encountered in the area has a distinctly coarse cleavage structure, but is easily broken apart, unless very dry, when it is moderately resistant. In other places the material is a soft mealy silt to a depth of several feet.

The type occurs in the extreme southeastern part of the area on the point of highland between the Mississippi and Missouri rivers, and in another area on the south side of the latter stream, where it is most typically developed. The surface is distinctly hilly, as a result of pronounced stream action, but in only a few places along the river bluffs is it sufficiently rough to prevent ordinary cultivation. The slope of the surface and the porous nature of the soil to a depth of several feet provide thorough drainage. Where the slope is excessive, erosion is active, and this troublesome tendency of the soil must be constantly guarded against.

The type is derived from loess, and represents that phase which contains the least clay. It grades westward imperceptibly into the Miami silt loam.

All the crops common to the region are grown on this soil. Corn usually yields from 45 to 60 bushels, wheat, 22 bushels; oats, 40 bushels, and hay from 1 to 1½ tons per acre. The character of the soil is such that it is less affected by seasonal variations, especially rainfall, than perhaps any other type in the area. Water is readily absorbed, and its movement is sufficiently free to prevent excessive accumulation at any point which would cause injury by drowning or freezing the roots of crops. Owing to its texture and structure, large amounts of water are retained in the soil for long periods, and by careful management the crops may withstand protracted droughts with little injury. All forms of tree vegetation make a strong and luxuriant growth. The forest species include elm, maple, oak, hackberry, hickory, walnut, basswood, and boxelder. Fruit trees also make an excellent growth and are long lived. Apples, peaches, cherries, and plums among the tree fruits, and strawberries, raspberries, blackberries, currants, and grapes in the small fruit class, grow very well on this type of soil, and are produced in considerable quantities. Near St. Charles and below the Missouri River are several profitable apple and peach orchards, as well as some vineyards.

The soil is fairly well adapted to all the ordinary grains, grasses, and leguminous forage plants, and is perhaps better suited to the growing of corn than to the finer-rooted wheat. It is admirably suited to the growing of apples, peaches, and cherries, and to a variety of small fruits. No other type in the region so fully unites the essential requirements of a general-purpose soil.

The following table gives mechanical analyses of typical samples of this soil:

Mechanical analyses of Memphis silt loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10963	1 mile NW. of St. Charles.	Gray friable silt, 0 to 16 inches.	0.0	Tr.	0.3	0.3	3.3	85.7	10.3
10964	Subsoil of 10963	Yellow silt, 16 to 36 inches.	.0	.0	.2	.2	2.8	87.2	9.5

ROUGH STONY LAND.

Rough stony land includes all those parts of the area where stones are a part of a soil formation. The surface material, which has a depth of from 8 to 30 inches, is a dark-colored silt loam that contains from 10 to 40 per cent of rock fragments, chiefly limestone, generally less than 3 inches in diameter. Beneath this silt occurs either a loam or a heavy, variously colored, silty residual clay, containing from 15 to 65 per cent of rock fragments; or, again, the silt may rest directly on the bed rock. This latter condition is most common on the steeper slopes.

The type occurs in every part of the area on the steeper slopes along the streams. It is most abundant along Callaway Creek and the tributaries of Wolf Creek in the southwestern part, and along the upper course of Big Creek in the west-central part. None of the areas are large or continuous for a long distance, and their occurrence depends on the character of the slope.

Rough stony land is really the result of the outcropping of the rock formations underlying the loess, from which some silt has been washed and mingled with the residual material from the rocks, or which, mingled with organic matter, forms a thin veneer over their surface. The surface usually lies at a considerable angle, and at several points nearly vertical ledges of rock occur. On the east side of the Mississippi River a part of the ledge is composed of sandstone, and sand is sometimes present in the soil in noticeable quantities. It is needless to add that the drainage of this soil type is thorough. The surface is too steep to permit ordinary cultivation, and nearly all of it is occupied by timber, consisting chiefly of oak and hickory in the western part, with a mixture of elm, maple, and other species in the eastern part. Where the soil is shallow the timber growth is small.

A few small areas have been cleared and planted to peaches and apples, but success can not be assured. Occasionally very small areas are included in cultivated fields. In orchard planting care should be taken to select areas where there is a sufficient depth of soil to sustain the tree in dry seasons. The character of the original timber may be taken as a guide in this matter. Some of the type might also be utilized in grape production. The relatively large quantity of organic matter in the soil, however, might stimulate too large a growth of wood and thus impair the quality of the fruit.

WAVERLY SILT LOAM.

The soil of the Waverly silt loam to a depth of 18 inches or more is a yellowish-gray to brown silt loam, in which may be seen a considerable quantity of very fine gray sand. Throughout much of the type a silt loam very similar to that forming the top soil extends to a depth of from 4 to 6 feet. The material is often roughly stratified, and thin bands of very fine sand and silt of light color are included.

This soil occupies the lower level along all the smaller streams, and forms a narrow ribbon through which the stream channel winds. It also occurs in narrow areas in front of the river bluffs. In this position it is found in every section of the area, but the largest bodies are seen along the Cuivre River and Dardenne Creek, and in front of the river bluff north of O'Fallon. Here the area attains a width of a half-mile or more. The surface is nearly level, with a slight upward slope to the bluff below which it occurs. The areas are also slightly higher next to the stream. A great part of the type is subject to overflow at infrequent intervals.

The Waverly silt loam owes its origin to this process of erosion and overflow, and represents the material washed from the loess, which occurs at a higher level. In the process some of the clay is carried away in the water while the sand and silt, mingled with organic matter, are deposited.

The texture of this type, which varies with the conditions of deposition, is finest along the Cuivre River and coarsest near the heads of the smallest streams, in which latter position the silt frequently rests on a mass of rock fragments and residual material at a depth of 2 feet. Along a number of streams in the northern part of the area 12 or 15 inches of light-colored silt rests on 2 feet of heavier silt of a darker color, which grades downward into a less heavy and lighter colored silt. The lighter surface portion probably represents the material deposited since cultivation began. Except at times of overflow the type is well drained. The rapid rise of the streams and their consequent overflow can not well be prevented, and in the bottoms the crops are occasionally destroyed in this way.

This type of soil is easily worked at almost any season, and presents no serious hindrances to cultivation. It is naturally very productive and has good moisture-conserving power.

It is cultivated to grains and grasses, and the yields are large. Corn sometimes yields from 60 to 100 bushels, wheat from 20 to 30 bushels, oats 50 bushels, and hay 2 tons per acre. It is a better soil for corn than for wheat, because it is light and warm, while the high content of organic matter causes wheat to lodge badly. It is well adapted to the production of potatoes, late truck, and melons, and in some places strawberries would do well.

The following table gives mechanical analyses of typical samples of the Waverly silt loam:

Mechanical analyses of Waverly silt loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10838	1 mile SE. of Brussels, Ill.	Silty loam, 0 to 14 inches.	0.1	0.4	0.2	1.0	18.4	71.3	8.5
10768	½ mile E. of Owen	Brown silty loam, 0 to 18 inches.	.0	.3	.1	.5	5.6	73.3	20.1
10769	Subsoil of 10768	Brown silty loam, 18 to 36 inches.	.0	.0	.1	.6	8.4	76.5	14.3
19839	Subsoil of 10838	Silty loam, 14 to 36 inches.	.1	.2	.2	.6	9.4	72.0	17.5

WAVERLY CLAY LOAM.

The Waverly clay loam, to a depth of 10 inches, is a heavy gray silt loam. From 10 to 18 inches below the surface there usually occurs a mixture of light-gray silt and very fine sand, beneath which is found a heavy drab or pale-yellow clay that extends to a depth of from 4 to 20 feet and rests on sand. In a few places the soil is quite dark, owing to the accumulation of organic matter.

The type is confined to the bottom lands along the Mississippi and the immediate tributaries of that river. The largest bodies, several square miles in extent, are located between the Cuivre River and Dardenne Creek. Small bodies are distributed along the Cuivre River as far up as Moscow Mills, and along Big and Dardenne creeks in the uplands. The surface is level and nearly flat and is traversed by a very few abandoned stream courses that have been nearly filled up with deposits from frequent overflows. These courses occur in such a way, however, that they are frequently the means of

flooding considerable areas of country by permitting the passage of backwater.

The flat surface, the impervious character of the subsoil, and the position of the type tend to interfere with drainage. Water accumulating from rain or other sources disappears slowly, and these conditions have developed a very distinctive timber growth, which consists almost entirely of pin oak, and gives rise to the local term "pin-oak land." The large area of this soil adjacent to the Cuivre River on the main bottom is nearly all in timber of this character. The other areas are mostly cleared and under cultivation. The greater part of the type is within the flood plain and is subject to occasional overflow. The surface is usually highest next to the bluff, and areas in this position are seldom flooded, except in limited areas from the small streams from the uplands. Such is the position of the type near Winfield and Brevator. Its occurrences along the Cuivre River to a point 5 miles southwest of Old Monroe lie particularly well, their elevation being from 20 to 40 feet above the ordinary level of the stream. These bodies, of course, are never overflowed, and because they do not receive deposits from floods are somewhat less productive. They are somewhat lighter than the typical soil and closely resemble the heaviest phase of the Miami silt loam.

The clay subsoil was probably deposited by slow-moving flood waters, under conditions similar to those under which additions are at present being made to the Yazoo clay. These deposits have been modified and later covered by silt carried down by the streams from the uplands and deposited from the water when it spread beyond the banks. It will be observed from a study of the map accompanying this report that the type occurs adjacent to these local streams and forms a transitional type between the Waverly silt loam and the Yazoo clay. The light color of the upper subsoil results from the leaching of the water along the top of the impervious clay that forms the lower subsoil, and the fact that the upper part of the soil section is largely a silt indicates that there was a considerable movement of the water from which deposition occurred. Mixed with this surface material is a large number of small, round, iron concretions like those found in parts of the Miami silt loam, from which, presumably, a large part of them has been derived.

Artificial drainage has scarcely been attempted on this type, beyond leading furrows across the surface and plowing in narrow lands. Much of the soil is wet, and therefore cold, rendering it unsuited to crops like corn. Wheat is the chief crop grown, and from it the best results are obtained. Yields of from 30 to 35 bushels per acre are recorded, but in a wet season from 15 to 20 bushels would represent the average. The yields of corn, oats, and all other crops started early in the spring are generally rather low. Hay yields as much as

2 tons per acre. If in proper moisture condition the soil cultivates well.

Undoubtedly the best treatment for this type is to establish thorough underdrainage. The mechanical condition of the soil would be greatly improved, ordinary surface water would be carried away, and the land quickly dried to the proper condition as soon as the flood water subsided, thus resulting in a minimum loss of growing crops. After such treatment corn, wheat, oats, and hay could be grown more successfully. Much improvement in the productive power of the soil is possible under proper management.

The following table gives mechanical analyses of typical samples of this soil:

Mechanical analyses of Waverly clay loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10844	1¼ miles E. of Horseshoe Lake.	Heavy silty loam, 0 to 15 inches.	0.4	1.1	0.4	0.4	4.4	73.1	19.9
10727	1¼ miles E. of Moscow Mills.	Heavy silty loam, 0 to 10 inches.	1.1	2.6	.3	3.7	5.9	62.2	23.1
10845	Subsoil of 10844	Gray stiff clay, 15 to 36 inches.	.2	.8	.3	.4	3.1	60.0	35.2
10728	Subsoil of 10727	Brown sticky clay, 10 to 36 inches.	.1	.7	.6	1.6	2.3	38.5	56.2

YAZOO CLAY.

The soil of the Yazoo clay, ranging in depth from 3 to 12 inches, is a heavy black clay loam, or a heavy black clay, slightly loamy. The subsoil in most cases is a very heavy dark-drab or black clay, sometimes highly plastic and waxy, extending to a depth of several feet. When moist the soil has a tendency to be sticky and to adhere to an auger or other implement inserted in it. Because of this quality it is locally referred to as "black sticky land," and the heavier phase is sometimes also spoken of as "gumbo."

The Yazoo clay, with unimportant exceptions, is confined to the large river bottoms. Large bodies of the type occur throughout the Mississippi bottom, and as parts of islands in the main stream. Areas of considerable extent also occur in the Illinois bottom, but only a few bodies are found in the Missouri bottom. The surface of the type, though comparatively flat, is rendered uneven by many old slough ways, and in the bottoms of these sloughs, on the islands, and

on the immediate banks of the Illinois River the type has a somewhat lighter subsoil than in the remaining areas. This subsoil is black in color and has some of the qualities of a heavy clay loam. Nearly all of this phase is covered by a mixed growth of hardwood timber. Some portions of the type in the Illinois bottom form a medium-level terrace abutting against the high land, and the surface has been somewhat dissected by stream action. In this position the soil material is of the very heaviest character, and most of it is covered by a scanty growth of gnarled black oak. In the Mississippi bottom the type forms a considerable extent of prairie covered by coarse, wiry grass and sedge.

Practically all of the type is within the flood plain and is covered with water more or less regularly. Water several inches deep stands on the surface in certain areas for a considerable time after the floods subside. This water comes both from the large streams that flow through the bottoms and from the small streams that come down from the uplands. The largest four of these low-lying areas are distributed as follows: One a mile southeast of Winfield, the second between Brevator and Old Monroe, the third extends from a mile below Cuivre River to near Peruque Creek, and the last lies south of this creek opposite St. Peters. Together these areas cover a number of square miles. South of the Mississippi River, at the extreme eastern margin of the survey, the elevation, however, is such that even the heavy floods of 1903 did not cover the areas. Near Peruque there are two large lakes, and an effort is being made to drain them. The soil in these, so far as it could be examined at the time of the survey, appeared to be a little lighter and deeper than that of the surrounding type and very rich in organic matter, and the subsoil seemed of about the same texture as the soil.

The Yazoo clay is sedimentary in origin, being formed by flood-water deposition, and the material has been accumulated from widely separated regions higher up the rivers. East of Winfield and near Peruque several thousand acres, as well as a few small areas elsewhere, are protected by levees and are cultivated. Some other areas are also under cultivation, and when water does not interfere the crop yields are large. The main drawback to the cultivation of this soil is the poor drainage. Within leveed areas surface ditches are used to remove the surplus water, and at other points in the area a few acres have been tiled. Thorough drainage would make this type the most productive in the area for several crops. Reclamation of some portions of the Yazoo clay, however, would be a rather difficult and expensive process, requiring in some places levees 10 feet high to be effective against the highest floods, as well as a complete system of both surface drainage and underdrainage. The problem of drainage

will be discussed more fully in another place. Even in the swampy areas, however, large yields of hay—4 to 7 tons per acre—are secured.

This soil type is preeminently suited to wheat, which is the chief crop grown, and yields of 50 bushels per acre are reported, though the average is probably not more than 30 bushels. Corn is grown to a limited extent, and yields from 30 to 50 bushels per acre. Timothy will make from 2 to 3 tons, if not winter-killed. These yields are obtained only under good seasonal conditions and freedom from flooding. Corn and oats, especially the latter, would grow well if the ground were in proper condition at seeding time, and cabbage, onions, and sugar beets would also do well.

The following table gives the results of mechanical analyses of typical samples of the Yazoo clay:

Mechanical analyses of Yazoo clay.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct*
10973	2½ miles NE. of Brussels.	Dark silty loam, 0 to 12 inches.	0.0	0.0	0.4	1.6	4.3	72.6	20.9
10847	1 mile E. of Brussels	Black sticky clay, 0 to 6 inches.	.6	1.3	1.0	2.5	4.6	50.2	39.7
10975	½ mile S. of Kampville Station.	Black clay, 0 to 12 inches.	.1	.5	1.0	5.0	3.5	48.3	41.6
10848	1 mile SW. of Maple Lake.	Clay, 0 to 7 inches	.3	1.7	4.4	9.0	2.0	37.0	45.6
10974	Subsoil of 10973	Dark silty loam, 12 to 36 inches.	.0	.2	.2	1.0	3.0	78.2	17.4
10976	Subsoil of 10975	Dark heavy clay, 12 to 36 inches.	.2	.5	.4	.8	1.2	52.8	44.1
10849	Subsoil of 10848	Heavy clay, 7 to 36 inches.	.2	2.3	5.1	11.3	1.8	29.8	49.3
10846	Subsoil of 10847	Gray, stiff, heavy clay, 6 to 36 inches.	.1	.9	.7	6.6	7.2	23.3	61.2

YAZOO LOAM.

The Yazoo loam is an exceedingly variable type, and no definite general statement of the character of the soil and subsoil can be made. Over a large part of the type the soil, to a depth of from 10 to 30 inches, consists of a heavy silt or clay loam of black color, beneath which is a deep gray fine sand. The remainder of the type has a gray or dark-brown fine sandy loam from 10 to 25 inches in depth and variable within the soil section. This rests on a roughly stratified dark heavy loam, which changes to a fine sand at a depth of several feet. The sandier top soil occurs on the banks of the streams

or along some main channel, and is most abundant in the Missouri bottom. In many places the variations from the light to the heavy material occur within such short distances that it is impossible to separate them on the map.

The type is confined to the bottoms of the Mississippi and Missouri rivers, adjacent to the main streams, and forms the greater part of a number of large islands. In all it has an extent of several square miles.

The surface is low and comparatively flat, but it is much cut up by many small abandoned stream courses. These courses lie generally parallel to each other and form inequalities that are a serious hindrance to cultivation. Greens Bottom and the large bottom southwest of it on the Missouri River are the highest and most level portions of the type, and the rich loam forming them is under a high state of cultivation. The common variation consists in the occurrence of heavy loam in the old stream courses and light sandy loam on the low ridges forming their banks. The phase having a heavy top soil is the more prevalent. Most of the islands are very low and are covered with hardwood timber.

The drainage of the depressions is poor, while that of the ridges is good except during floods. Standing water is of common occurrence in the depressions.

The material forming the Yazoo loam is the most recent deposit of the rivers, and is being added to during every overflow. The fine sand is the deposit from the swiftest currents, and is usually found where the water leaves the main channel. Deposits 2 feet in depth were laid down by the high water of 1903. The basal sand was first deposited as sandbars, and the heavy loam was laid down by slow-moving currents after the surface had been raised considerably above the medium water level. In the Missouri bottom the meanderings of the stream are effecting a rearrangement of much of this type by cutting away at one point and redepositing at another. In this way several hundred acres of valuable land of this character have been destroyed, while the new land formed will not be suitable for cultivation for a number of years.

Nearly all of the mainland part of the type in the Missouri bottoms and considerable areas on some of the islands are cultivated and produce large yields of corn, oats, and wheat. Along the Mississippi some cultivation is practiced, corn being almost exclusively the crop. Damage by floods is a constant menace. Corn yields from 50 to 100 bushels and oats from 40 to 50 bushels per acre. Along the Missouri River wheat yields have reached 30 and 35 bushels per acre, but this crop has a greater tendency to lodge than on the heavier soils. In the areas along the Missouri some orchard and small fruits are grown

with good results. On the medium heavy areas potatoes yield from 200 to 250 bushels to the acre.

On the whole the conditions of the Yazoo loam are such that corn is the safest and most profitable crop, although potatoes, melons, and a variety of late and medium late truck crops and small fruits may be produced with success. Crops maturing in a single season are to be preferred on this soil. In general its working qualities are good, and the frequent inundations render fertilizers unnecessary.

The following table gives mechanical analyses of typical samples of the Yazoo loam:

Mechanical analyses of Yazoo loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10979	1 mile N. of Mona	Gray loam, 0 to 13 inches.	0.0	0.0	0.0	4.1	34.8	51.2	9.9
10977	1 mile S. of Millers	Dark clay loam, 0 to 20 inches.	.0	.0	Tr.	2.1	17.7	56.2	23.9
10978	Subsoil of 10977	Fine sandy and silty loam, 20 to 36 inches.	.0	.0	.0	5.4	52.1	37.4	5.1
10980	Subsoil of 10979	Dark silty clay, 13 to 36 inches.	.0	.1	.4	2.1	3.1	60.6	33.7

MIAMI FINE SAND.

The Miami fine sand is a dark-gray or brown fine sand from 10 to 12 inches deep and sometimes rather heavy, underlain by a gray or brown fine sand.

The type forms a narrow strip at Deerplain, in Illinois, in the position of a terrace 20 or 30 feet above the adjacent bottom land, and occupies, besides, several small areas in exposed positions in the Missouri bottom. Its surface is gently rolling, and frequently billowy where the wind has been active in the movement of the sand. Except during floods the type is well drained, and much of it is quickly affected by dry weather.

The elevated portions were probably formed by the river long ago, when it flowed at a much higher level than at present. The remaining low-lying parts are the result of very recent deposition, and comprise such bodies of light sand associated with the Yazoo loam as are large enough to be shown on the map.

Probably two-thirds of the type is cultivated to corn and wheat. Its productive power is low. Corn yields only from 20 to 35 bushels per acre and wheat in proportion. Strawberries and other small

fruits and truck are grown, with fair results, near Deerplain. At that point apples are also being tried, but marked success should not be expected on so light a soil in that position. When well manured and carefully cultivated it is an excellent soil for early truck, strawberries, and melons.

The following table gives mechanical analyses of typical samples of this soil:

Mechanical analyses of Miami fine sand.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10834	½ mile S. of Deerplain, Ill.	Fine sand, 0 to 12 inches..	0.0	2.4	14.4	69.9	4.6	5.8	2.9
10835	Subsoil of 10834	Fine sand, 12 to 36 inches.	.2	2.3	15.4	72.3	3.6	3.4	2.7

SIOUX SANDY LOAM.

The soil of the Sioux sandy loam, to a depth of from 20 to 25 inches, is a black or dark-brown sandy loam, composed of silt, sand, clay, and a low percentage of fine gravel. It grades downward into an iron-stained, waterworn gravel, in which the bowlders seldom exceed 2 inches in diameter. These gravel beds are several feet in depth, roughly stratified, and composed largely of fine gravel.

This type is less than a square mile in extent. It forms a low bar removed a short distance from the bluff at Brevator, includes fragments of an ancient river terrace at Old Monroe, and appears at a couple of points between Brevator and Winfield. The surface is gently rolling, having an easy slope, and the basal gravel was evidently deposited by swift local currents and later covered by the sandy surface material. The drainage is good and the type is not subject to overflow.

A maximum yield of from 70 to 80 bushels of corn and from 30 to 40 bushels of wheat, per acre, are produced on the area at Brevator, and large yields of good potatoes have been obtained. The yield of all crops is large in moist seasons, but dry weather affects growing plants in a short time.

In addition to corn and potatoes the type is well adapted to melons, medium truck crops, and small fruit.

The following table gives mechanical analyses of fine earth of typical samples of this soil:

Mechanical analyses of Sioux sandy loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay. 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10840	¼ mile E. of Brevator.	Black sandy loam, 0 to 20 inches.	9.0	39.3	12.4	7.3	4.4	13.3	14.3
10841	Subsoil of 10840.....	Brown sand and gravel, 20 to 36 inches.	32.5	47.2	10.8	1.5	.9	1.1	6.0

DRAINAGE.

Throughout the 165 square miles of bottom land along the large rivers the factors that most largely govern crop production from year to year are the drainage of the soil at times of normal water level in the streams and the protection of the crops from inundation at times of high water. On the uplands, also, considerable areas of the heavier phase of the Marion silt loam would be much benefited by the use of tile drains, even where there is a considerable slope in the surface of the fields. At ordinary times they would tend to aerate the soil and to put it in such physical condition that when excessive rains occurred more of the water could be stored without injurious effects and the surplus quickly carried away before injury to growing crops resulted. Winter heaving of crops like wheat would then be less severe, and leguminous crops could be grown much more successfully than under present conditions.

In the bottoms two methods of improvement, each beneficial in some degree, are practicable, but the best results are obtained from a combination of levees with surface drainage and underdrainage. In the past there has been a lack of concerted action toward this end on the part of the small farmers, and not enough capital under one control to accomplish much, except in two comparatively small areas.

A 5-foot levee has been built around several square miles near Winfield, mostly outside the limits of the present survey. Where it was observed this levee ranges in height from 3 to 8 feet, and is effective in most seasons, though it was overtopped by the unusually high water of 1903. South of it, and extending down to a point near the Cuivre River, is a large body of land, at present largely uncultivated, a superficial examination of which indicates that a levee 8 feet

in height would be a sufficient protection. In this area, however, the flow of several small streams would have to be cared for.

Near Peruque 3,000 acres are under a levee constructed in 1896, which has been an adequate protection every year save one since that time. In one season the 2,500 acres seeded to wheat yielded 94,000 bushels, or an average of 37 bushels to the acre. This is the best yield that has been obtained.

It is, of course, possible to levee all the bottoms, and although in some instances the probable returns under present conditions would hardly warrant the necessary expenditure, nearly all of the Mississippi bottom, it is believed, could be protected and fair returns on the investment obtained.

The common method of drainage is by the use of surface ditches and by plowing in narrow lands. Where open ditches are constructed along every quarter-section line they are a considerable hindrance to cultivation and a permanent expense for maintenance. Besides, at this interval, they are not sufficiently effective, and drain furrows are necessary. This system is practiced within the levee near Peruque, and large reservoirs are constructed at the lowest point within the inclosure, the dirt excavated being used in the construction of the levee. At this point a pumping station is maintained to handle the surface water during the periods of flood, when the drainage system is not effective beyond the levee. It is now planned to have the reservoirs large enough to hold nearly all of the surface water at such times.

At other points tile drainage is in use and is said to be effective, the drains remaining in good condition. If this be true, large open main ditches, with tile drains as laterals, would be the ideal system. It is claimed by certain practical men that the clay subsoil is too heavy for tile drains to be permanently effective. In any event, they should be constructed with a large fall, because large amounts of silt must be moved at times. Silt wells and protected inlets should be used.

Even if flooding were not prevented by a levee, a complete system of drains would be a great help. The high water seldom continues for many days, and as soon as it had subsided the land would be quickly dried to a cultivable condition. The general working properties and the moisture-holding power of all the heavier soils would be greatly improved by such treatment.

AGRICULTURAL METHODS.

In the O'Fallon area the average depth of plowing is from 4 to 6 inches, and the common practice in cultivation is to use large-shovel, deep-running implements and to leave the crop on a ridge at the end

of the season. This method should be abandoned on all types of soil. Except perhaps on some of the deep black loam, upland prairie soil, and on the Waverly silt loam the depth of plowing should be gradually increased to from 7 to 10 inches, with proper packing of the under part of the furrow slice. This will give a much greater area for the extension of the plant roots and render the crop less susceptible to slight seasonal variations. Furthermore, the cultivation of all crops should be made as level as possible by the use of small-shovel cultivators, and weeders where effective, run to a depth not exceeding 3 inches, and the operation should be repeated about twice as often as under the present system. Effort should be made to maintain a good shallow mulch and to avoid pruning off the feeding and supporting roots of the growing plant. This method of plowing and cultivating is essential to successful crop production under any but the most unusual conditions and can not be too strongly impressed on the mind of the farmer. This practice has been adopted by a few farmers in the area surveyed, with most profitable results, and the general need for such a system is strongly emphasized by the great difference in the returns from different farms of the same size and same character of soils.

The value of barnyard manure is recognized, and it is used chiefly on corn land. Commercial fertilizers are used on wheat in amounts usually less than 200 pounds to the acre, and profitable results are obtained.

Grain and hay are the chief crops. As has been indicated, wheat is about the only crop produced on some of the heavy bottom soils, and is also considered best suited to the heavy uplands. Large amounts of corn and oats are also grown. The rotation generally practiced on the uplands is pasture or meadow land plowed for corn, to which the barnyard manure is applied, followed by wheat or oats, then wheat seeded to timothy in the fall and clover added in the early spring. Hay and pasture usually occupy the land for two years. In recent years there has been much difficulty in securing stands of grass in this manner, and the rotation has undergone some change.

Cattle and hogs are kept in considerable numbers and consume most of the corn, oats, and hay. Silage is used very little. A larger variety of leguminous crops should be tried and more care exercised in their seeding and management. It is believed that on the uplands less wheat and more forage should be grown. Alfalfa and cowpeas should succeed on all the lighter areas of the Miami silt loam, and, with good drainage established, on the heavier areas also. They will do well on the Memphis silt loam and the Waverly silt loam.

AGRICULTURAL CONDITIONS.

The farming class, as a rule, is fairly prosperous. The farms range in size from less than a hundred up to several hundred acres. The following statements regarding conditions are based largely on the figures of the Twelfth Census for St. Charles County. So large a part of that county is included in the area surveyed, and the general conditions in the adjacent counties are so similar, that the figures may be accepted as representative of the area.

Nearly 75 per cent of the land is improved, and the average value per acre is $35. From $30 to $60 is about the range of prices for good general farming land with fair buildings. The average size of farms is 130.7 acres, and the average value of buildings per farm is $1,154. The farmhouses as a rule are not large or expensive, but are substantial and comfortable. Most of the barns and other outbuildings are small. The average value of farm machinery is $220 per farm, and that of domestic animals is $615.

The people are a thrifty and very conservative class, who do not quickly change their methods of farming. This makes for stability, if not always for the greatest success. Too little regard is given to agricultural literature. In St. Charles County 44.9 per cent of the farms are operated by the owners, and renting is practiced to a very considerable extent. Both the crop and cash rent systems are in vogue. On the best land the owner prefers a grain rental of from two-fifths to one-half of the crop in marketable condition. Cash rents range from $2 to $4 an acre.

The leading crops of the area, in the order of their importance, are wheat, corn, hay, oats, and potatoes. The average yields for the whole area are wheat, 14 bushels; corn, 33 bushels; hay, 1¼ tons; and potatoes, 100 bushels to the acre.

The value of live stock fed and sold for meat is large, but satisfactory figures are not available. Wentzville and Troy are important shipping points for stock. Around Wentzville and Winfield considerable dairying is practiced, and there is a creamery at New Melle. In the region around Wentzville the value of the poultry and eggs produced is many hundred dollars annually.

Fruit growing is receiving much more attention than formerly, particularly on the points of highland between the large rivers in the eastern part of the area. Apples are much in the lead in acreage and value, the orchards covering several thousand acres. In the Illinois part a rough estimate of their extent would be between 3,000 and 4,000 acres, of which half or more has been planted within the last two years. At several points in the Mississippi bottom large plantings of apple trees have lately been made, and some small orchards are in bearing. These plantings have been made on the

Waverly clay loam and Yazoo clay. It is questionable whether these will be a commercial success. On the uplands the industry has a substantial, practical, and profitable basis. In Illinois the fruit is sold on the trees to outside buyers and is shipped to market by way of the river. Peaches, which could be successfully produced, are not grown because of the inconvenient shipping facilities. The varieties of apples most planted are the Ben Davis, Jonathan, Janette, and Willow Twig. Very little attention is given to the production of small fruits and truck.

There is a general recognition of the adaptation of crops to soils, as has been indicated in the discussions of the various soil types, but this adaptation is by no means always considered in planning the crop rotations or in deciding upon the crop to be grown.

While the general conditions in the area are good, there is much opportunity for improvement along the lines of better drainage, deeper plowing, and more shallow and frequent tillage, larger production of leguminous forage, more live stock on the uplands, and more careful attention to manuring and to the maintenance of the crop-producing power through rotation and other means. The value of farm land in every section of the area would be greatly increased by improving the country roads, nearly all of which are unsurfaced. By placing a stone crusher in each township and applying crushed limestone, which is found in all of the hills, excellent roads could be maintained. There are large sections in the area at a considerable distance from shipping points, and the construction of better roads would remove one of the difficulties in the way of further agricultural development.

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