

SOIL SURVEY OF MARION COUNTY, MISSOURI

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DESCRIPTION OF THE AREA.

Marion County, Mo., containing 437 square miles, or 279,680 acres, is situated in the northeastern part of the State, about 115 miles northwest of St. Louis and 50 miles south of the Iowa State line. It

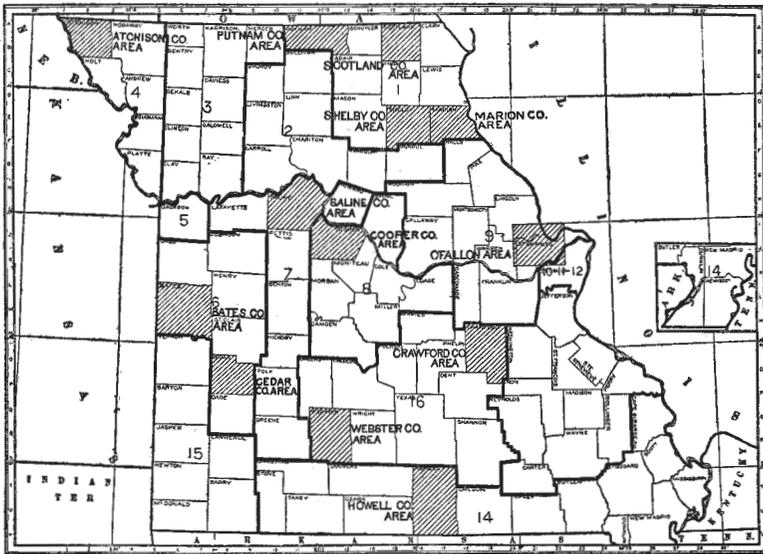


Fig. 37.—Sketch map showing location of the Marion County area, Missouri.

is separated from Illinois on the east by the Mississippi River, is bounded on the north by Lewis County, on the west by Shelby, and on the south by Ralls and Monroe Counties.

The topography varies from rolling or hilly to almost flat. Rapid, and at times greatly swollen, streams have dissected the area with numerous valleys and gullies. The level interstream uplands, called prairies, have the same general trend as the streams, which is northwest and southeast. The valley and gully walls are usually steep, and in places precipitous. The gullies are gradually working back farther into the uplands, but their retrogression is not so rapid now as for-

merly, because much of the steeper land is being kept constantly in pasture.

The bottom lands of the Mississippi River occupy a considerable proportion of the county. They are separated from the higher parts of the county by a precipitous bluff, which extends the whole length of the area, except where broken by the valleys of the smaller streams. The bottoms have a flat, smooth surface, except for the bayous and channels cut at times of overflow.

The elevation of the county varies from about 460 feet along the Mississippi River Valley to 729 feet near the village of Ely, the highest recorded elevation in the county.

The first settlers in Marion County came from Kentucky in 1818, and established their homes near the spring at Palmyra. Many others followed the next year, and considerable land was cleared. The first cornfield of any size—20 acres in extent—was planted in 1820. There was open prairie land in the county at that time, but it was covered over with such a dense sod that it was more trouble to break it with the crude implements then available than to clear the more friable forest land. The open prairie land was the last to be put under cultivation. All the tillable parts of the county are now under cultivation. The farmers, a large percentage of whom are of German extraction, are thrifty and prosperous.

There are not many new settlers coming into the county, and a few are moving out, the high price of good land causing emigration to regions of cheaper land. The only lands recently developed have been some of the wet, marshy tracts along the Mississippi River, which have been diked, drained, and brought into profitable tillage.

The principal streams in the county are the North and South Fabius Rivers and the North and South Rivers. The Fabius Rivers flow in a southeasterly direction and the North and South Rivers flow in a northeasterly direction and enter the Mississippi River near Kimball Island. Bear Creek, entering the river at Hannibal; Clear Creek, which empties a few miles north of Hannibal; and South Fork of North River are other streams of considerable importance. All these streams are perennial, but many of their smaller tributaries are intermittent. None of the streams in the county are navigable.

Hannibal, in the extreme southeast corner of the county, is the largest town, with a population of 18,341. It is a thriving river town, where much manufacturing is carried on. It is the junction point of five railroads. Palmyra is next in importance, with a population of about 2,168. It is the county seat and located near the center of the county. Woodland, Ely, Taylor, and Withers Mills are railroad villages and shipping centers of some importance. Philadelphia, Emerson, Nelsonville, Warren, Newmarket, and West Ely are small villages without shipping facilities.

Quincy, Ill., lies just across the Mississippi River from the northeast corner of the county, and serves as a trading and shipping point for that section. Monroe City, in Ralls County, is situated near the line, part of the town being in Marion County.

Marion County has a good system of public schools, and there are several other institutions of learning. An academy is located in Palmyra, and there are good graded schools and a fine business college in the city of Hannibal. The county also has access to the schools of Quincy, Ill.

This county is not well supplied with railroads, especially in the western part. The only railroad operating in the county west of Palmyra is a branch of the Chicago, Burlington & Quincy Railroad which crosses a small portion of the southwest corner. At present there is a railroad, the Hannibal & Northern Missouri, now being built from Palmyra to Philadelphia and westward. The Missouri, Kansas & Texas Railroad traverses a very small part of the county in the southeast corner. The Chicago, Burlington & Quincy Railroad runs from Hannibal to Quincy up the Mississippi Valley, and the Quincy, Omaha & Kansas City Railroad traverses a small part of the northeast corner. The Mississippi River is bridged at Hannibal and at Quincy.

River transportation is available at Hannibal and Quincy, and there is some shipping from farm landings at various places through the county. The eastern part of the county thus has a choice of shipping places, while the western part has none. An electric line is now being built from Hannibal to Palmyra and Philadelphia, and thence to Shelbyville. This will be of great benefit to the western part of the county.

Hauling by wagon in the winter season, except on graveled roads, is very difficult, owing to the deep, silty nature of the dirt roads. Many of these have been graveled, and in time practically all the roads in the county will be thus improved.

CLIMATE.

Marion County rarely suffers to any great extent from extreme climatic conditions. The winters are not unusually severe, a temperature of -15° to -20° F. being only occasionally recorded. The snowfall is commonly heavy, affording good protection to winter wheat. Late spring frosts injure early vegetation, and occasionally, as was the case this year, the entire fruit crop is destroyed. On this account it is not wise to engage in fruit growing on an extensive scale.

Crops sometimes suffer locally from an excess of moisture. This is due to the close, impervious nature of the subsoil in some parts of the area, and not to excessive rainfall. Occasional heavy, dashing

rains cause severe erosion, but this is usually well guarded against by keeping the more sloping areas almost constantly in pasture. In general, the run-off is rapid and the inland streams are often swollen to such an extent as to damage crops planted in the bottom lands.

The data in the tables below, taken from records of the Weather Bureau station at Hannibal, show the normal monthly, seasonal, and annual temperature and precipitation, the maximum and minimum, the direction of prevailing wind and highest velocity, and the dates of the first and last killing frosts.

Normal monthly, seasonal, and annual temperature and precipitation, wind velocity and direction at Hannibal.

Month.	Temperature.			Precipitation.			Wind.	
	Mean.	Absolute maximum.	Absolute minimum.	Average.	Total for driest year.	Total for wettest year.	Prevailing direction.	Maximum velocity per hour.
	° F.	° F.	° F.	Inches.	Inches.	Inches.		Miles.
December.....	31	69	-18	1.3	1.8	1.1	SW.	46
January.....	23	77	-15	2.2	1.9	3.6	SW.	52
February.....	27	69	-25	2.0	1.3	1.6	NW.	48
Winter.....	27	.....	.....	5.5	5.0	6.3	.....	.....
March.....	42	91	0	2.5	2.8	6.4	SW.	54
April.....	53	90	19	3.3	1.6	3.5	WSW.	60
May.....	64	91	30	5.0	1.6	6.9	SW.	54
Spring.....	53	.....	.....	10.8	6.0	16.8	.....	.....
June.....	73	100	43	3.6	2.5	4.8	SW.	52
July.....	76	108	47	4.0	1.9	4.2	SW.	56
August.....	75	100	47	3.3	.9	1.0	SW.	49
Summer.....	75	.....	.....	10.9	5.3	10.0	.....	.....
September.....	68	101	32	3.5	1.8	8.9	SW.	57
October.....	56	91	20	1.7	.9	2.9	SW.	43
November.....	43	80	4	2.0	.7	2.6	SW.	48
Fall.....	56	.....	.....	7.2	3.4	14.4	.....	.....
Year.....	54	108	-25	34.4	19.7	47.5	.....	.....

Dates of first and last killing frosts at Hannibal.

Year.	Last in spring.	First in fall.	Year.	Last in spring.	First in fall.
1892.....		Oct. 25	1902.....	Apr. 8	Oct. 14
1893.....	Apr. 23	Oct. 24	1903.....	May 1	Oct. 18
1894.....	Apr. 11	Oct. 8	1904.....	Apr. 21	Oct. 23
1895.....	May 14	Sept. 30	1905.....	Apr. 17	Oct. 12
1896.....	Apr. 3	Oct. 21	1906.....	Apr. 1	Oct. 10
1897.....	Mar. 27	Oct. 29	1907.....	Apr. 21	Oct. 13
1898.....	Apr. 15	Oct. 23	1908.....	Apr. 30	Oct. 12
1899.....	Apr. 4	Sept. 30	1909.....	May 1	Do.
1900.....	Apr. 12	Oct. 8	1910.....	Apr. 24	.....
1901.....	Apr. 20	Oct. 5	Average.....	Apr. 17	Oct. 14

AGRICULTURE.

During the first years of the settlement of this county, 1819 to 1825, very little farming was done beyond that required to supply food and clothing to the family. For several years after the county was settled cotton, hemp, and flax were grown, and about 1830 cotton was grown quite extensively and a cotton mill was built. There were too many drawbacks to cotton culture in this climate and it was soon abandoned. Flax was grown for many years, and the fiber spun was woven at home. Shoes were made at home from home-tanned leather. Hemp, which was the money crop, was grown extensively until about 1850 and then gradually declined and finally was abandoned. None of the three crops mentioned above are grown here at the present time.

In 1820 one field of corn—20 acres in extent—was planted, and by 1831 corn had become the principal crop, but in that year, owing to heavy rains in the spring and a killing frost in August, the crop was almost a complete failure. Seed corn was very scarce the following spring, and the resulting conditions, closely approaching a famine, caused great suffering in the county.

In 1839 a large number of cattle were bought in the southern portion of the State and driven to Marion County. This was the beginning of the local cattle industry, which is an important phase of the present agriculture.

Wheat and oats have been grown since 1835–1840, but not extensively until after the invention of reaping machinery. Clover was introduced 50 or 60 years ago and since has held an important place in the agriculture of the county. Potatoes were grown by the first settlers for home use. Alfalfa is of recent introduction. Hay has always been an important crop.

The agriculture of Marion County is far above the average in this country. Many of the soils are productive and up-to-date methods,

including the rotation of crops and the use of improved farm machinery, are employed in almost all phases of farming. In the eastern part of the area the farmers are perhaps more prosperous because of the excellent soil, and they are less so in the western part because of the very rugged topography and poorer soil. The stream valley lands in the western part are fertile and on them good crops are grown. The farmers of the more hilly sections, however, do very well considering the conditions with which they have to contend. In the eastern part the barns are large and well constructed and many of the dwellings are well built and commodious, with all the conveniences of modern city homes.

The crops grown in Marion County, in the order of their importance, are hay, corn, wheat, oats, and potatoes. Rye, tobacco, and market truck are minor crops.

The hay crop consists almost wholly of timothy and clover. In the early history of the county hay was cut from the uncultivated prairie lands, and at the present time a large quantity of swamp grass is cut in the unleveled portion of the Mississippi bottom, but this is practically all sent to the paper mills at Quincy, Ill. Timothy seed is sown with wheat in the fall, and clover is sown on the same land in the spring. After the wheat is cut the hay crops soon cover the ground, and in seasons of ample rainfall a light crop of hay is cut the same fall. The following summer a heavy crop of hay is usually harvested, the yield being in many cases as high as 3 tons per acre. The crop is practically all stacked in the field.

The speed and ease with which hay is handled here is remarkable. After it is cut and cured it is hauled with a large "bull rake" and a patent stacker lifts the whole load to the stack by horsepower. Some hay is sold, but most of it is fed to live stock. If the resulting manure is carefully conserved, which unfortunately is not always the case, very little of the fertilizing value of the crop is lost.

Corn is grown by every farmer in the county. The yield in the eastern part is often as high as 75 bushels per acre. Corn is usually planted in clover sod and stable manure is added in liberal quantities, a practice which is ideal for corn growing. It is invariably planted in hills with a two-horse planter and check-rower attachment. The crop is cultivated both ways with improved riding or walking cultivators, some of them taking two rows at a time. When the crop is ripe it is cut and allowed to stand in shocks and is husked later either by hand or with a power shredder. A considerable percentage of the crop is made into silage. Some corn is sown very thick and cut for forage.

The best soil in the area for corn in favorable seasons is well-drained bottom land. The upland produces a good crop every year,

except on the flat hardpan or prairie land, where it is a partial failure in seasons of excessive rainfall.

It is not the practice to apply commercial fertilizers to corn. Stable manure is the only, and much the best, fertilizer to use. On soils such as are found in Marion County the maintenance of systematic crop rotations and the application of liberal amounts of stable manure are all that is necessary to keep the soil in a high state of fertility.

Wheat is a very important crop, being grown by nearly every farmer in the county. The Mississippi bottom land, where leveled and well drained, is perhaps the best wheat land in the area. This year, 1910, when the wheat crop was below the average in other parts of the county, the yield in some parts of the bottoms averaged 30 bushels per acre, and with no fertilizer except a small amount of stable manure.

Wheat is sown in the fall from September to October with an ordinary grain drill, no spring wheat being grown in the county. Usually corn or oats stubble land is used. Some farmers are beginning to use small amounts of commercial fertilizer, as it aids in securing a good stand of clover and timothy and increases the yield of wheat. The wheat crop is cut with the ordinary self-binder and shocked in the usual way. In some cases it is hauled to the barn and stacked, but most of it is thrashed from the field.

The principal varieties grown here are Turkey, Fulcaster, May, and Zimmerman. Farmers usually save their seed wheat from their own crop. This is a commendable practice, as it is no advantage to change seed. The farmer, however, should make every effort to bring his product to the highest degree of perfection by careful cultivation and selection.

The Hessian fly is giving considerable trouble in this county and preventive measures should be adopted in order to keep the pest in check. Late seeding, the burning of stubble after harvest, the use of resistant varieties, and sowing a small area of wheat early as a trap crop and plowing it under when thoroughly infested with the fly, are some of the methods of control that have been suggested. Wheat should not be sown earlier than the date of the appearance of the fall brood, which date varies somewhat with the location and the season.

Stinking smut has been troublesome at times, but in general does not cause much damage. Sprinkling seed with a 10 per cent solution of blue vitriol (copper sulphate) will almost entirely prevent the disease.

The acreage of oats in the county this year is very large and the yield exceptionally good. In some parts of northeast Missouri

certain small fields have yielded as high as 80 bushels per acre; 60 bushels per acre is not an uncommon yield. The crop is usually grown without commercial fertilizer, but is sown on the stubble of corn which has been heavily manured.

Oats do best on the higher lands in the eastern part of the county. In the river bottom and in the smaller stream valleys they grow too rank and lodge before harvest time.

The farmers here have found that it is better to plow corn stubble land for oats rather than to disk it, and to drill the seed rather than broadcast it. It was the practice at one time to sow oats upon land with little preparation of the seed bed, often sowing the seed broadcast and harrowing in with a spike-tooth or disk harrow. This practice has been abandoned in recent years, for it has been learned that oats respond to good treatment as well as other crops. The crop is cut with an ordinary binder and usually thrashed from the field.

The soil east of Palmyra as far as the river bluff and extending the whole length of the county seems to be well adapted to alfalfa. Some alfalfa fields are seen here. It will no doubt do well in the Mississippi bottoms, if more thoroughly drained, but so far it has not been tried on the bottom-land soils. The presence of hardpan and the consequent poor drainage also make it probable that the soils of the flat prairies are not suitable for the crop.

Potatoes produce excellent yields in the lighter soils of the area, but are not largely grown for market, though nearly every farm produces enough for home use.

Sorghum, millet, tobacco, and rye are produced to a very small extent. The farmers of this county are generally not anxious for the introduction of new crops; they are doing very well with the ones they have. With the exception of alfalfa and millet, which have lately been introduced, and cotton, hemp, and flax, which were given up many years ago, the crops of this county are about the same as they were when the county was first organized.

The live-stock industry has always been of much importance to Marion County, both in the way of money returns to the farmer and in keeping up the fertility of the land. Some of the early settlers brought cattle, hogs, and sheep with them, and since then, although the price at times has been extremely low, the industry has gradually grown in importance until the number and quality of live stock raised in this county are far above the average.

Horses are perhaps of first importance, as far as value is concerned. Many fine stallions, principally of the Percheron and Belgian draft breeds, are owned in the county, and there are also several good jacks. The American jacks are preferred to imported breeds. Large numbers of young mules and horses are sold from this county every year. Both horses and mules are used for farm work, horses predominating.

Ever since the disastrous cattle speculation of 1839 there has been great interest in cattle raising. The industry was early profitable because of the good pasturage and the abundant supply of wild-grass hay harvested from the prairies. In later years large numbers of cattle have been shipped into the county, usually in the spring or late winter, and kept on pasture land during the summer. They make good gains with but little attention or expense. They are sold in the late summer or early fall, the sales usually depending somewhat on the condition of the market. A considerable number of home-raised beef cattle are also sold from the county every year. The principal breeds are Angus, Hereford, and Shorthorn, with a few Galloway and Polled Durham.

Twenty-five or thirty years ago several German families moved into this county and engaged in dairying. This has gradually grown in importance until it is one of the leading industries in the county. The cream is separated either at home or at the creameries and the skim milk retained on the farm and fed to pigs and calves. The dairy herds are almost exclusively of Jersey blood.

Considerable attention is being paid to hog raising in this county. The principal breeds are Duroc Jersey and Poland China. They are fattened in the summer on old corn with a small amount of green corn cut from the field, and are sold in the fall when they are 7 to 8 months old.

Sheep raising is still of some importance, but is said to be slowly declining. Some goats are brought into the county in the spring and ranged on the rough, wooded land in the western part. They are not kept over winter, but are sold in the fall for butchering. There is one flock of 500 well-bred Angoras in the county.

Farm labor in this county is efficient but rather scarce. The present season farmers paid \$2.50 a day for labor during harvest time. Laborers who work by the month receive \$20 to \$30, and when land is rented a charge of \$3 to \$6 an acre is made. Most of the farmers work their own land. Machinery is used wherever practicable. It is now possible for a man and a boy to do about all the work on a quarter-section farm.

SOILS.

The soils of Marion County are predominantly fine in grain and light in color. The coarsest grained soil mapped in the county is a fine sandy loam and the finest grained soil is a clay, not, however, an extremely heavy clay.

Some of the bottom land soils are black and all of the Mississippi River bottom soils are dark in color, but the upland soils are almost universally light in color. There are about two upland types that can be called dark, and these are of small extent.

The soils are mainly glacial, loessial, and alluvial in origin. Twenty-nine per cent of the area is occupied by glacial soils, 20.8 per cent by alluvial, and 12.8 per cent by types derived from the loess, while 25.3 per cent is occupied by a type composed of material that has the characteristics of the loess, although it may have had some other derivation. Only about 12.1 per cent is of residuary origin. The largest percentage is loessial in origin or characteristics, the next largest is glacial, the two making up 67.1 per cent of the total area of the county. The percentage of alluvial soils is larger than in the average area of this size in the United States on account of the width of the Mississippi bottoms.

The loessial soils are of two kinds. One kind has a brownish color and a rather uniform silty material throughout both soil and subsoil. The other has black or gray silty soil with heavy brownish, yellowish, or mottled clayey subsoil. The first is derived from a silt deposit of Pleistocene age carried to its existing position by water or wind. It occurs only on the uplands and only along that part of the uplands lying near the Mississippi River bottoms. It reaches a maximum width and therefore a maximum distance from the river bluff of about 7 miles. The layer of material is thick near the river valley and gradually becomes thinner westward until it entirely disappears. This is the belt of material known as the original loess or bluff loess. This soil is mapped as the Knox silt loam. It will be noticed that the material occurs in the hilly portions of the county and in many cases on both the slopes and in the valleys as well as on the uplands.

Lying west of this area and confined to the smooth uplands is another soil material in some respects resembling the material just described. It consists of a top layer, where erosion has not removed it, of gray to black silt with a maximum thickness of about 16 inches. The lower inch or two is a nearly white silt. Beneath this lies a tough clay, mottled gray and dark reddish brown. This varies from a thin film to a layer about 6 inches in thickness. Beneath this lies a mottled yellow and gray silty clay, extending downward to the bottom of the deposit, usually about 8 or 10 feet. Where no erosion has taken place, as is the case on the flat prairies of the western half of the county, the whole section here described exists typically. On the slopes, however, the character of the soil depends upon which of the layers above described is exposed at the surface. It may be the tough clay, in which case the soil is tough and sticky. It may be the lower silty clay layer, in which case the soil will be intermediate in character between the silt of the flat uplands and the tough clay of the second layer. The subsoil will be of about the same material as the soil. The soil derived from this lower layer of material has been uneroded, so that the soil is a silt, while the subsoil is heavier. Very small areas occur in which the lower layers have furnished the soil

material, so small in fact that they have not been separated in mapping. The soil derived from this material are the Putnam and Marshall soils.

It is not at all improbable that the whole of this deposit, including the three layers described above was, when first formed, a single deposit of essentially the same physical constitution from top to bottom. According to this view the upper layer of silt is merely the residue left after the finer clay particles have been washed out by percolating water and the tough clay layer underneath it is merely the lodging place for the clay particles. The silty clay layer still lower down is the original unmodified material unchanged by percolating water. An alternative hypothesis ascribes to the upper silt layer a wind-blown origin and to the lower layer a sedimentary origin. There is nothing in the former hypothesis inconsistent with a wind-blown origin for the material originally. The hypothesis as given applies mainly to the processes by which the differentiation into layers was brought about. The material is of Pleistocene age and was deposited about the close or soon after the close of the Kansan Epoch.

Lying beneath this material and outcropping only where it has been uncovered by erosion occurs another soil material. It is found only on slopes and rather low areas within the upland portion of the county. The material is essentially a clay with a varying proportion of sand and boulders. The sand is usually medium to coarse and reaches a maximum quantity, where not locally concentrated by recent erosive action, of about 50 per cent of the soil mass. The boulders are predominantly small, the greater part of them being gravel rather than boulders and a large percentage of them rather water worn. They have been derived from a great many kinds of rocks, mainly igneous and metamorphic. Locally, chert fragments are rather abundant and thoroughly rounded quartz pebbles are usually present.

The soils derived from this material are the Shelby soils. This material, as well as that from which the Putnam and Marshall soils are derived, has a wide distribution in northern Missouri. It is an ice-laid deposit left by the Kansan ice sheet of the Glacial period.

Beneath the deposits described above lie the foundation rocks of the county. They are of great age and supported a land surface long before the glacial deposits made possible the existing one by burying the old one.

These old rocks can only occur at the surface in places where the glacial material has been taken away. They lie in any particular locality lower down on the valley slopes, therefore, than the lowest of the glacial deposits of that locality. The soils derived from them are of limited distribution.

These rocks are of two principal kinds. The most important in point of distribution and character is a limestone. It varies from a very fine grained, thin-bedded rock to a coarse-grained, crystalline, massive bedded one. The former is practically free from interbedded chert, while with the latter there is a great deal. The soils in like manner vary from chert-free to very cherty types. The Clarksville soils are derived from these rocks.

The other consolidated rocks consist of a series of interbedded yellowish or greenish-yellow to grayish-yellow shales and very fine grained sandstones. They occur at the surface at only a few places in the county, and give rise to the material from which the Hannibal soils are derived.

The coarsest as well as the finest textured soils in the area are found among the alluvial soils. These are formed from material carried down by the streams and deposited from currents of varying velocity. The texture of these soils ranges from a fine sandy loam to clay of medium to heavy character, the coarser textured material being found along the smaller tributary streams where the currents were relatively swift, and the clays occurring in the broader areas in the Mississippi bottoms. The heaviest of these clays usually occur in the interstream areas in the bottoms, and remote from the stream channels, where there has been a tendency to the formation of slack water areas of considerable relative duration.

The name and extent of each of the soil types mapped are shown in the following table:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Shelby loam.....	81,216	29.0	Sarpy fine sandy loam.....	9,280	3.3
Putnam silt loam.....	70,848	25.3	Wabash silt loam.....	8,576	3.1
Knox silt loam.....	29,888	10.7	Marshall silt loam.....	5,952	2.1
Clarksville stony loam.....	27,904	10.0	Hannibal silt loam.....	5,760	2.1
Jackson loam.....	20,160	7.2	Wabash very fine sandy loam.	4,480	1.6
Wabash clay.....	9,606	} 5.6	Total.....	279,680	.....
Heavy phase.....	6,010				

POTNAM SILT LOAM.

The surface soil of the Putnam silt loam consists of 5 to 8 inches of dark-gray or dark-brown heavy silty loam containing relatively large quantities of organic matter. The subsoil is a heavy dark-gray or drab silty clay, mottled with light red or brown and sometimes marked with bluish streaks. Between the soil and subsoil there is almost always found a layer of light-gray or whitish compact silty material which crumbles between the fingers and is very smooth and powdery when dry. This layer varies in thickness from 1 inch to 6

inches and is quite impervious to water. This soil differs from the Marshall silt loam, which it closely resembles, in that its surface is almost flat and it has a heavy impervious subsoil.

The drainage of the Putnam silt loam is poor and in most places the surface is so level that open ditches will not carry off the water rapidly enough to prevent injury of growing crops. Often in the spring the soil is too wet to work long after other soils are in good condition. If plowed when too wet very resistant clods are formed and much time and labor are required to get the soil in a good tilth again. In many places there are small areas of a swampy character, where water-loving weeds and grasses grow luxuriantly. Tile drains would generally be beneficial to the type, and a few short lines have been put in. They should be more extensively used. Some means should be devised to keep this soil free from excess water, for when in good moisture condition it is one of the best soils in the county. If plowed in small lands so that a deep furrow is left between them, the surface water will be removed quickly where there is sufficient fall, but deeper ditches are necessary to remove the excess water which the soil itself has taken up.

This type occupies large nearly flat areas in the central part of the county. It has never been forested and is known as prairie. It was the last land to be taken up by the early settlers, because of the absence of springs and the difficulty of breaking the tough resistant prairie sod with the rude plows of early times.

The crop yields are lower than on the other upland soils of this county. Corn on an average produces about 30 to 40 bushels per acre, wheat 15 to 20 bushels, and oats 20 to 30 bushels. These figures refer to yields secured without the use of commercial fertilizer. Farmers on this soil are beginning to use commercial fertilizers, and as a result the yields have been increased, but the practice is almost certain to have a bad effect on the land unless stable manure or clover or other green crops are plowed under. This soil is of such a nature that if allowed to become deficient in organic matter it will change into a very intractable and unproductive soil. Thorough drainage and the maintenance of a good supply of decaying vegetable matter are the most urgent needs of this type. The rotation of wheat, clover, corn, and oats commonly practiced in this county will, if drainage is accomplished, keep this soil in good condition.

The price of this land ranges from \$20 to \$40 an acre according to location.

The results of mechanical analyses of soil, subsoil, and lower subsoil of the Putnam silt loam are given in the following table:

Mechanical analyses of Putnam silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
24413.....	Soil.....	0.4	1.9	0.6	0.7	9.0	67.7	19.5
24414.....	Subsoil.....	1.2	4.0	1.3	1.0	6.5	70.2	15.9
24415.....	Lower subsoil.....	.2	.9	.5	.7	11.3	42.2	44.1

SHELBY LOAM.

The Shelby loam consists of a silty loam of a grayish or brownish-gray color from 5 to 6 inches deep, resting upon a yellowish-red or brownish-red fine sandy clay, which extends to a depth of 5 to 8 feet. In the subsoil lime concretions and iron pipes are sometimes found and considerable quantities of cherty gravel are always present. The type is associated with the Putnam silt loam, occupying the upper slopes of stream valleys and gullies, and is of glacial origin.

The native forest growth is principally scrub oak with a considerable mixture of hickory and basswood. Drainage is excessive and the run-off rapid, so that erosion is severe during heavy rains. In times of protracted drought the soil becomes very dry.

Little of the type is cultivated being used principally for pasture, for which it is very well adapted. Some fine apple orchards extend down onto this soil from the silt loam above and the trees seem to do equally as well as on any other type in the area. There is reason to believe that fruit of almost any kind may be grown.

Wheat, corn, and oats have been grown to a limited extent, but none of these crops yield good returns on account of the inadequate supply of moisture during the late summer.

The Shelby loam is not considered a good soil in comparison with the higher-lying silty soils or the bottom or river valley soils. It is poor perhaps on account of its origin and the fact that erosion about keeps pace with disintegration. Where cultivated, this soil should not be allowed to lie through the winter without a cover crop, such as wheat, winter oats, or rye. Stable manure should be added frequently and a heavy crop of clover should be plowed under at least once in three years. If properly handled, this soil will produce profitable crops but where other more level soils are available it should be used for pasture.

The type is quite extensive in the aggregate, but no large area is found in any one place. Nearly every farm in the county includes

some of this type, and since good springs are abundant on it or just below it, and pasture grasses thrive, it makes an ideal range for live stock.

KNOX SILT LOAM.

The soil of the Knox silt loam ranges from yellowish-brown to dark-brown silt loam, 8 to 14 inches deep. The subsoil consists of a compact, yellowish silty clay becoming heavier with increase in depth. While the subsoil is quite heavy, it is pervious, and rainwater readily passes downward into the subdrainage. The type is locally known as "Elm woods" land, having been covered originally with forest composed principally of elm. Many fine large elms are still to be found on this type.

The Knox silt loam occupies rolling to hilly areas principally in the eastern part of the county. West of Palmyra very little of this soil is found. It extends east to the Mississippi River bluff and forms a belt about 5 or 6 miles wide along the east side of the county.

The underlying material is glacial drift, and in some places is only a few feet below the surface. Except in the gullies and on some of the slopes, the silty covering is of such thickness that the glacial till below has no effect on the agricultural value of the type. On the steeper slopes the drift is exposed or covered with only a very thin mantle of silt loam.

The Knox silt loam is considered among the best soils in the county, and some of it near Palmyra is held as high as \$150 an acre. The system of crop rotation followed in cultivating this type has maintained its natural productiveness and the yields are probably as large now as they ever were. Some stable manure is added every year, and a few of the farmers are beginning to use commercial fertilizer, but this practice should be discouraged, as the soil, if properly handled, can be kept in good condition more economically by following the practices that have prevailed to this time. Fifty to 70 bushels of corn, 40 bushels of oats, and 20 to 35 bushels of wheat per acre, without commercial fertilizer, are not uncommon yields on this type. Hay, potatoes, and alfalfa give excellent results. Crops are seldom if ever injured by excessive rain, and, on the other hand, dry weather does not often cause a reduction of yield.

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

Mechanical analyses of Knox silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
24404.....	Soil.....	0.0	0.1	0.2	0.4	10.4	68.2	20.8
24405.....	Subsoil.....	.0	.0	.2	.5	4.4	71.8	23.4

MARSHALL SILT LOAM.

On some of the more level and elevated areas of the Knox silt loam is found a soil much resembling the latter, except that it contains more organic matter and is darker, almost black in color. This type, the Marshall silt loam, consists of 10 to 15 inches of dark brown or black loam or silt loam resting on a subsoil of a light brown heavy silt loam or silty clay.

The topography in places is nearly flat and is never very uneven. There is, however, sufficient fall to give good surface drainage and the soil and subsoil are of such a nature that the movement of water into the subsoil is not impeded.

This is without doubt the best upland soil in Marion County, everything considered. It is, however, of small extent, being found only in a few small areas in the eastern and northern parts of the county. Wheat, corn, oats, alfalfa, timothy, all the clovers, and potatoes are grown with excellent results.

The natural forest growth is elm and the type is included in what has been known as "Elm woods" land.

WABASH SILT LOAM.

The Wabash silt loam is a dark-gray to black impervious silt loam with a depth of 12 to 15 inches, underlain by lighter colored, heavy, impervious silty clay. In places there is a layer of almost pure silt between the soil and subsoil. In the lower depth of the subsoil there are mottlings of yellow, light brown, and drab.

This type occupies a broad belt in the Mississippi River bottoms near the bluff in the central and lower parts of the county. It is composed of sediment from standing or slowly moving water, and is somewhat influenced by the silty soils of the adjacent uplands. The soil is all poorly drained, and crops very often are damaged by heavy rains. Where levees have not been constructed, crops are sometimes destroyed by floods.

This is naturally a productive soil, but needs thorough drainage, which can be effected only by the use of tile because of the flat topography in most places. In the central part of the county levees have been built and this soil is being put into good tillable condition. In the northern part there are as yet no levees. If well drained this soil is unsurpassed for small grains. Corn also does well. The natural forest growth is principally red oak, with soft maple along the streams and bayous.

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

Mechanical analyses of Wabash silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
24418.....	Soil.....	0.2	0.5	0.6	1.0	0.7	82.1	14.7
24419.....	Subsoil.....	.0	.7	.5	.6	.7	73.6	23.8

WABASH VERY FINE SANDY LOAM.

The soil of the Wabash very fine sandy loam, to a depth of 10 to 15 inches, is a dark-gray, black, or occasionally brown, fine sandy loam. The subsoil is a dark-gray fine sandy loam or fine sand, usually becoming somewhat lighter with increase in depth. The subsoil is sometimes yellow in the lower depths, and occasionally some fine rounded gravel is found.

The type is alluvial in origin and occupies a considerable proportion of the Mississippi River bottoms, lying next to the bluff principally in the northern part of the county. In the central and southern parts the Wabash silt loam occupies the same position. The surface of the type is almost flat.

When not overflowed and with a season of moderate rainfall this soil is very productive. It lies somewhat higher than the other soils of the bottoms, but is often covered with water when the river is in flood. Its structure is sufficiently open, so that crops seldom suffer from excess of precipitation, but overflow water does some damage. A system of levees to protect the bottom lands in the northern end of the county is now proposed. When the system is completed this soil will be among the most valuable in the county. In favorable seasons heavy crops of corn, wheat, oats, and hay are grown. The type is particularly well adapted to the clovers. Some excellent yields of alsike clover were produced on it this summer.

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

Mechanical analyses of Wabash very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
24420.....	Soil.....	0.0	0.1	0.4	27.4	22.3	40.2	9.2
24421.....	Subsoil.....	.0	.2	.7	48.6	23.5	18.5	7.8

WABASH CLAY.

The surface soil of the Wabash clay is a dark-gray to black heavy clay with a depth of 5 to 7 inches. In dry weather the soil sun cracks badly, and if plowed before a dry period the soil eventually breaks up into small cubes. The subsoil is a gray or drab rather heavy clay which becomes slightly lighter in texture as depth increases. At about 5 feet layers of fine sand are sometimes found.

The type is of considerable extent in the county, occupying as it does a large part of the Mississippi bottoms. It is a little lower lying than the silt loam of the same series.

Although the Wabash clay is naturally very productive, its use in the past has been hampered by the frequent destruction of crops by overflows. In recent years this danger has been eliminated by the construction of levees, and the type has become the most valuable in the county. As far as natural productiveness is concerned, this soil is unsurpassed. Tile drainage has proved very successful and profitable on this soil, as well as on all other soils in the river valley.

Heavy phase.—A heavy phase of the Wabash clay occupies the lower portions of the Mississippi bottom, and is found usually near shallow bays or swales. The soil to a depth of 8 to 10 inches is a dark-gray or black, heavy, impervious clay, underlain by a lighter colored but heavier clay that becomes more tenacious with depth. It is locally known as "gumbo."

Its low-lying position prevented its cultivation until a few years ago. The natural productiveness of this soil is bringing it into prominence, even though there is danger of crops being entirely ruined by excessive rain. Drainage systems are now being installed on the larger areas with a view to removing the excess moisture in times of continued rain.

The crop yields on this heavy phase of the type in favorable seasons are very high. Wheat often produces 40 bushels to the acre, corn as high as 80 to 100 bushels, and oats 50 to 70 bushels. Such crops are produced without any fertilizer or manure.

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

Mechanical analyses of Wabash clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
Typical:								
24426.....	Soil.....	0.0	0.3	0.6	14.2	12.7	34.9	37.4
24427.....	Subsoil.....	.0	.6	.7	12.5	14.3	30.4	41.6
Heavy phase:								
24430.....	Soil.....	.0	.8	1.0	4.5	9.9	42.6	41.3
24431.....	Subsoil.....	.1	.6	.9	1.3	2.8	43.3	50.9

SARPY FINE SANDY LOAM.

The soil of the Sarpy fine sandy loam to a depth of 8 to 12 inches is a dark-gray to nearly black light sandy loam. The subsoil is a dark-gray sandy loam, becoming lighter in color and more sandy below 20 inches, and at 30 inches almost a pure sand of dark yellowish gray color.

The type occurs as narrow belts along the larger streams, where it represents deposits left by flood waters. It is still in process of formation, each succeeding overflow leaving a thin deposit of fine material on the surface.

This is a good corn soil, and much of it is in cultivation, although crops are sometimes destroyed or severely injured by high water. The damage is greater on areas along the North and South Fabius Rivers than on those lying on the North and South Rivers, severe floods being more frequent on the former system than on the latter. The type is not of large extent in this county and therefore not of great importance.

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

Mechanical analyses of Sarpy fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
24424.....	Soil.....	0.0	4.1	7.4	24.8	26.7	23.0	14.1
24425.....	Subsoil.....	.0	3.7	13.8	34.6	21.8	14.9	11.1

JACKSON LOAM.

The surface soil of the Jackson loam is a brown or light-brown loam 12 to 15 inches deep. The subsoil is a heavy light-brown silty or fine sandy clay, which in the lower depths is usually mottled with reddish brown and contains small iron concretions. The top soil varies considerably in texture, having in some places a noticeable percentage of silt or fine sand.

The type occurs as second bottom. Small areas or strips of it are found along the four principal rivers in the county. It is alluvial in origin, although it is largely influenced by the uplands adjacent to it. The surface, though in some places quite level, is mostly rolling, and the soil is well drained. A very small percentage of it lies low enough to be occasionally overflowed.

The Jackson loam is a good soil for general farming and is highly prized. It produces heavy yields of corn, small grain, and hay. The type retains moisture very well, and if there be a good market

for such products it would be a splendid soil for truck. In the vicinity of Hannibal some of it is used for market gardening.

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

Mechanical analyses of Jackson loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
24398.....	Soil.....	0.0	3.8	11.3	18.5	23.8	26.3	16.3
24399.....	Subsoil.....	.3	3.6	14.0	21.5	21.2	20.2	19.1

HANNIBAL SILT LOAM.

In the lower parts of the deep gullies and on steep hillsides in the southwestern part of the county is found a soil which is derived from outcrops of Hannibal shale. The surface 3 to 6 inches is a light or yellowish-gray silty loam, containing a high percentage of shale fragments. The subsoil is almost invariably unweathered shale of a yellowish-gray or light-gray color.

The soil is naturally very poor, and because of this, together with its rugged topography, very little of it is in cultivation. Much of it is covered with a scrub growth of trees and underbrush, and some portions of such tracts are used as goat ranges.

This type of soil in Marion County is not extensive, and it is doubtless best to allow it to remain in forest.

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

Mechanical analyses of Hannibal silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
24394.....	Soil.....	1.0	2.9	2.4	3.6	4.7	63.4	21.9
24395.....	Subsoil.....	.2	.8	1.0	1.5	5.9	51.2	39.1

CLARKSVILLE STONY LOAM.

Immediately overlying the Hannibal shale is the Burlington limestone—a formation which gives rise to areas of the Clarksville stony loam. It is found in the more shallow gullies and valleys occupying a position similar to that of the Hannibal silt loam. The soil is not extensive, but is found in small narrow strips on the valley walls in all parts of the county.

The surface soil, to a depth of 5 to 8 inches, is a dark reddish brown silty loam carrying a high percentage of chert and limestone frag-

ments. The subsoil is a brownish-red, rather heavy, silty clay also containing rock fragments.

This is naturally a soil of moderate productiveness but it is little cultivated on account of the rugged topography and high content of fragmental rock. Some areas are so steep and rugged as to be classed as Rough stony land. Such places are usually precipitous rock outcrops. Where the slopes are less steep and smoother the areas afford good pasture, for which purpose the type is perhaps most profitably used.

SUMMARY.

Marion County is located on the Mississippi River in northeast Missouri about 50 miles from the Iowa State line. Quincy, Ill., is just opposite the northeast corner of the county.

The topography, which is generally rolling, varies from nearly flat to very rugged. The bottoms of the Mississippi River occupy a considerable proportion of the county.

The elevation varies from 461 feet in the river bottom to 729 feet near the village of Ely. Water is reached by drilling at 30 to 90 feet.

Hannibal is by far the largest town in the county, and Palmyra, the county seat, is the next in size. All the other towns are small.

Shipping facilities are good in the eastern part of the county and poor in the western part. A railroad is now being built from Palmyra to Philadelphia and westward.

The agriculture is of a high type and the agricultural class is in general prosperous.

Wheat, corn, oats, hay, and potatoes are the principal crops.

Live-stock raising has been an important industry for many years. The industry is profitable by reason of good pastures and soil well suited to the production of forage crops.

The principal breeds of horses are the Percheron and Clydesdale. The most popular breeds of cattle are the Hereford, Angus, Red-Polled, and Jersey. The long-wool sheep are the only strains raised. The Duroc-Jersey, Poland-China, and Berkshire are the principal breeds of hogs. Many mules are raised.

The principal upland soils of the county have been derived from the glacial till and from the mantle of loess overlying it. Alluvial soils are found along all of the streams of the county, but are most extensively developed in the Mississippi River Valley. Below the glacial till is the Burlington limestone which outcrops in the gullies, and gives rise to the Clarksville stony loam. Below this is the Hannibal shale and the Louisiana limestone with its associated shales. The Hannibal shale gives rise to a small area of very unproductive soil in the central and southwestern parts of the area. The Louisiana limestone outcrops only in the deepest gullies and has no effect on the soils of the county.

The silty covering of loess extending over practically the whole county, gives rise to the Knox silt loam, the Marshall silt loam, and the Putnam silt loam. These soils are all very productive, except the Putnam silt loam, which needs drainage, and are ideal for farming purposes.

The soils of the Mississippi bottoms are extremely productive. They are in part protected from overflow by levees along the river. Plans to extend the system to the northern part of the county are being considered.

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