SOIL SURVEY OF PUTNAM COUNTY, MISSOURI.

By CHARLES J. MANN and W. E. THARP.

DESCRIPTION OF THE AREA.

Putnam County, Mo., is one of the northern tier of counties lying near the middle of the Missouri-Iowa boundary line, or about 80 miles west of Keokuk, Iowa. It is bounded on the north by Wayne and Appanoose counties, Iowa, on the east by Schuyler County, on the south by Adair and Sullivan counties, and on the west by Mercer

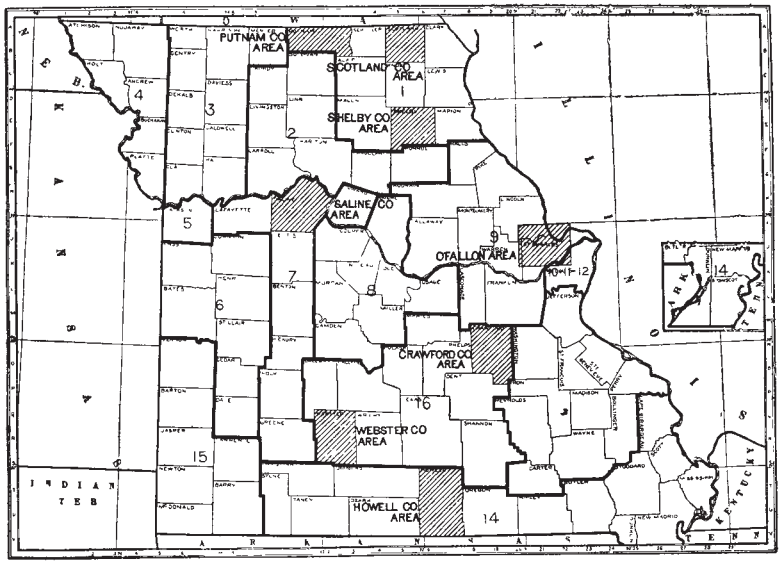

FIG. 30.—Sketch map showing location of the Putnam County area, Missouri.

County. It is situated between parallels 40° 23′ and 40° 35′ north latitude and meridians 92° 43′ and 93° 24′ west longitude. But for a 3-mile jog in the south line near the east end, the county would be nearly a rectangle—36 miles long, east and west, and 14 miles wide, north and south. The area includes 334,592 acres, or about 523 square miles.

While Putnam County is usually considered a part of the rolling prairie region of Missouri, the streams have caused a somewhat

varied topography. The surface may be considered in three topographic divisions, namely, the high, level, or gently undulating divides known as prairie; the more extensive rough and hilly regions along the water courses, and the wide, nearly level expanse of bottom lands. The bottoms are usually higher along the streams and lowest next to the bluffs, which are generally high and steep. The prairies are between 200 and 250 feet above the streams, as the elevations along the Chicago, Burlington and Kansas City Railroad show—Lemonville 1,075, Unionville 1,068, Mendota 880, and at the State line 890 feet above sea level.

The streams of the county belong to two drainage systems, separated by a comparatively narrow watershed running almost due north and south through the middle of the county. The eastern system includes Chariton River on the eastern border and its tributaries, Shoal and Blackbird creeks, which enter the county from Iowa and take a general southeastern direction, the former joining the river about midway between the county lines and the latter leaving the county about 2 miles west of the river. South Blackbird Creek rises west of Unionville and flows southeast into Blackbird, about 2 miles north of the south county line. With the exception of the main divides between these streams and the bottom lands, this part of the county is a series of high, narrow "hog back" ridges and deep, steep-sided ravines. The ridges are very winding and apparently have no special trend or direction.

The western system includes East Locust Creek, flowing straight south across the county 6 miles west of Unionville; West Locust, rising 3 miles west of East Locust but joining with it just above the county line; and Medicine Creek, which takes a more winding course across the county from north to south at an average distance of about 3 miles from the west boundary. The area within this drainage system is not nearly so rough and broken as the eastern, but contains much more prairie, and the "breaks" are gently rolling to rolling.

Settlement began in Putnam County some time prior to 1836, the land first taken up lying along Chariton River. The pioneers were from Virginia, Tennessee, Kentucky, and a few from more eastern States. They chose the timbered and watered sections in preference to the unfamiliar and more difficultly tilled prairie land. Settlement gradually pushed westward, until by 1855 nearly every part of the county was sparsely settled. The population increased speedily until the opening of the civil war. The census of 1900 gives a population of 16,688, of which only about 3,500 were in towns. The eastern part of the county is divided into comparatively small farms and the population is somewhat more dense than in the western part, where much of the land is in large holdings.

The final reorganization of the county came in 1845. After several changes in location the county seat was placed in the geographical center of the county and called Harmony. Later the name was changed to Unionville.

Three railroads traverse the county from north to south. A branch of the Chicago, Milwaukee and St. Paul in the western part along Medicine Creek, on which are the small agricultural villages of Lucerne and Powersville; the Iowa and St. Louis branch of the Burlington system along Chariton River bottoms, in the extreme east, touching the towns of Worthington and Livonia; and the Chicago, Burlington and Kansas City Railroad through the middle of the county, upon which Unionville, the county seat, is situated. The last named is a prosperous town of 2,500 population, in which some manufacturing has been developed. Mendota, in the northern part of the county, is supported largely by coal mining, and Lemonville, in the southern part, by agriculture. A railroad east and west through the county would be a great impetus to its development.

The public roads are usually good in the summer and fall, but almost impassable in early winter and again in spring. In many instance changing the roads from the ridges to the land lines has resulted in very hilly as well as muddy roads. The ridge roads, on the other hand, are almost always good.

CLIMATE.

The Weather Bureau maintains a station at Unionville, and the tables following were compiled from the records kept at that point.

It will be observed from the table giving the normal temperature and precipitation that nearly one-half of the annual rainfall occurs during the months of May, June, July, and August. The variations from the normal in these months may be studied by a comparison of the first with the second table, which gives the actual precipitation for May to August from 1900 to 1906, inclusive.

The marked extremes shown in this table fortunately are not of frequent occurrence. But departures from the normal of sufficient magnitude seriously to affect crops on soil not in good physical condition may be expected any year. The greater part of the rather light precipitation of the winter months is in the form of snow. While a foot or more may fall during one storm it is unusual for the ground to remain covered long. Generally the snow drifts off the exposed hillsides in fields destitute of a covering sufficient to hold it as it falls. This irregular distribution and the frequent thaws occasion much injury to fall-sown wheat and closely-cropped meadows.

A temperature of —28° F. has been recorded once or twice during the last seven years. The usual minimum, however, is —10° to

— 14° F., and usually such weather marks but a few days in January or February.

The highest recorded temperature during recent years is 111° F., in August, 1901. The maximum does not usually exceed 20° F. above the normal for July or August.

From such past records as are available it seems that the average growing season is about twenty-five weeks. The first killing frost occurs usually in October and the last in April.

The climatic conditions are favorable for the growing of corn, clover, grass, most of the orchard fruits, and garden truck. Wheat and oats would be benefited by a somewhat lower maximum temperature than usually prevails in the spring months.

Normal monthly and annual temperature and precipitation.

Month.	Unionville.		Month.	Unionville.	
	Temperature.	Precipitation.		Temperature.	Precipitation.
	°F.	*Inches.*		°F.	*Inches.*
January	26.0	1.50	August	76.4	4.76
February	24.1	2.41	September	67.6	4.75
March	37.4	2.01	October	56.5	2.01
April	52.5	3.46	November	38.2	1.60
May	65.0	5.20	December	27.6	2.80
June	73.6	4.68	Year	52.0	38.93
July	78.7	3.75			

Precipitation during growing season at Unionville.

Year.	May.	June.	July.	August.	Year.	May.	June.	July.	August.
	Inches.	*Inches.*	*Inches.*	*Inches.*		*Inches.*	*Inches.*	*Inches.*	*Inches.*
1906	3.59	3.89	3.08	3.97	1902	3.92	8.52	8.44	9.65
1905	5.89	3.98	5.75	3.46	1901	2.14	4.32	.77	.76
1904	4.16	3.15	5.56	4.57	1900	5.10	3.56	3.77	2.75
1903	8.78	3.85	3.03	11.52					

AGRICULTURE.

Wood and water were the features which determined the early settler's location; consequently the first land under cultivation was the rolling timbered land bordering the streams, where the pioneer could cut the timber for his cabin and the cleared ground would yield readily to his rather crude implements. The early agriculture was not only primitive, but meager. The first year a farmer broke about 10 acres and increased the number to possibly 20 in the second and third years. The aim was to produce only the corn, buckwheat, and vegetables required for the subsistence of the family and the work stock. Deer, wild turkeys, and smaller game were abundant

in the woods and the prairies, which insured a good meat supply, and the streams were stocked with fish.

The range was large and free, so that cattle supported themselves the year around on the luxuriant growth of wild grass, and hogs in large numbers grew and fattened on the mast. Following this line of least resistance, stock-raising was early resorted to as the main source of revenue. The quality of the stock was very poor—for the most part scrub cattle and "razor-back" hogs. Marketing was difficult, for stock had to be driven to Brunswick, 75 miles south, on the Missouri River, or to Alexandria, 80 miles east, on the Mississippi, and often hogs sold for as little as $1.50 a hundredweight. In 1860 a railroad was built to Ottumwa, Iowa, which became the main outlet for produce.

From 1850 to 1860 a great number of settlers came into the county from the east, took up prairie lands, and began the production of corn on a large scale. One man usually cared for 40 acres of corn and cut 40 acres of wild hay. Corn thus became almost the only crop, and it is probable that there was more grown then than now. As there was no means of transportation, the local demand by men who fed cattle was often more than supplied and the grain sold for as little as 12½ cents a bushel or was piled up to wait for higher prices. Winter wheat was tried to a limited extent in the early days, but it was thought the winters were too severe and the crop was abandoned. Buckwheat was also a secondary crop, but the hot August sun blighted the bloom and made the yield uncertain. Oats were grown only to a limited extent.

Agriculture was practically at a standstill during the civil war, but at its close was resumed with increased vigor. Oats became a primary crop, and if properly handled were a paying crop. They were grown especially as a nurse crop for timothy. Spring wheat had been introduced to replace the winter variety, and met with some success until 1868. Chinch bugs practically destroyed the crop of that year, and the effort to produce spring wheat was subsequently abandoned. About 1875 winter wheat was again tried and, meeting with more success, has since become a staple crop in certain parts of the county.

With the building of the railroad, stock raising received a great impetus, both from the improved animals which were introduced and from the fact that driving them to market was no longer necessary, for buyers came into the county, competed in prices and did their own marketing. The coming of the railroad through Unionville in 1872 served to strengthen the industry still more. Land became more valuable and was almost all fenced with high rail fences by 1868. Farmers began to seed down their cultivated ground for meadow and pasture, it being the aim to get as much timothy meadow and pasture

as possible to grow young cattle for sale as feeders in Iowa and Illinois. This industry reached its height in the last few years. There are still a great many grade cattle shipped in, but the local cattle for the most part belong to the Shorthorn, Hereford, and Aberdeen-Angus breeds. Poland China, Duroc Jersey, and Chester White hogs are the favorites. A great many horses and mules are raised and sold. Each farmer usually has his specialty—horses, mules, cattle, or hogs.

This industry has made a great many farmers well to do, but on account of low prices, high freight rates, and increased value of land it is claimed that this type of farming is no longer very remunerative, and the farmers are again plowing up their meadows and increasing the acreage of corn, wheat, and oats; the acreage of the cereals increased almost 7,000 acres in 1905 over 1904, while meadow land increased hardly 1,000 acres.

The principal crops at present are hay, corn, oats, and wheat. Corn and hay are most commonly grown in the river bottom and prairie region. Oats are more uniformly distributed in the uplands. Wheat is the important crop in the bottom and on slopes, principally in the southeastern part of the county. Most of the rolling land is in pasture or timber or both. This shows that some effort is made to adapt crop to soil.

Sorghum, millet, pumpkins, orchard fruits, and truck crops are secondary products, and not generally grown. None of these crops are shipped from the county, and the only source of revenue is from stock, poultry, butter, and eggs, the last three supplying many farmers with all their ready money. Dairying is becoming more popular and considerable cream is shipped.

The farmers owning small farms and the tenants grow the grain and sell it to the local stock grower for feed. None of the wealthy farmers attempt to raise all the grain they feed.

Until within the last few years there has never been any effort made to adopt a systematic rotation. Corn was kept on the same land until the yield diminished to a point where it became unprofitable, and then the field was sown to oats and seeded down and a new field put in corn. Mowing lands have been left until almost entirely taken with redtop and "dog wool," and the yield of hay became unremunerative. A rotation rapidly coming into favor is corn, oats or wheat, clover and timothy, left for hay four years, making a seven-year rotation.

Only a little farm labor is employed, and it is sometimes difficult to secure competent farm help. The mines attract a good many laborers. A good landlord, however, seldom has any trouble secur-

ing all the help he needs. Wages range from $15 to $20 a month, or $1.50 a day for shorter periods.

About 65 per cent of the farms are operated by their owners, the remainder being rented usually for the share of one-half the produce. Farms range in size from 20 acres up to 1,200, the eastern part of the county being taken up largely in small farms. Here the farmer works in the mines, hauls coal, cuts mine props, or does other jobs in addition to cultivating his land. The western part is taken up by large farms on which stock is raised almost to the exclusion of everything else. It remains for the average size farm of 125 acres to supply the grain. The largest farms are nearly always found on the Shelby silt loam.

Except near Unionville almost any farm in the county could be bought for $50 an acre. The average price is from $20 to $40. The small timbered farms improved with only rail fences, log houses, and inexpensive outbuildings can be had for $20 an acre and sometimes less, while the larger, well-fenced farms, on which are good two-story houses and well-built barns and buildings, command higher prices. Probably over half the farms are mortgaged, but most of these obligations have been assumed to enable the owner to purchase more land and are being paid off rapidly.

SOILS.

The history and processes of soil formation over Putnam County are in general fairly distinct and easily determined. Whatever residual soil had been formed from the limestones, sandstones, and shales of the coal measures, which are at present exposed only in deep stream cuts, was largely removed by the invading ice sheet of the great Kansan glaciation. This glacier with its talus filled the valleys, covered the highest elevations, and, upon receding, left behind it a comparatively uniform deposit of from 50 to 150 feet of close-structured blue bowlder clay, containing considerable sand and many bowlders. The surface of this glacial deposit or drift was probably nearly level, except for depressions caused by the settling of a greater mass of material over the previously existing valleys. The drainage water immediately sought these depressions and has greatly modified the topography of the drift by severe erosion, to which the material is very susceptible. The upper 5 to 20 feet of this deposit has also been modified by leaching, oxidation, and the carrying away in suspension of the finer particles of earth, leaving a yellow to reddish-yellow sticky sandy clay with an accumulation of sand on the surface. Frequent bowlders of granite, quartzite, and other rocks are left exposed. Many lime pebbles and white

calcareous streaks, together with occasional iron pipes, are found within a few feet of the surface. It is this modified drift which gives rise to the Shelby loam—the principal soil type of the area.

Succeeding this glaciation, and after sufficient time had elapsed to permit a soil to be firmly established, there was laid down a second deposit called "loess." It consists of about 2 feet of fine wind-blown material and was undoubtedly deposited uniformly over the entire area, but the severe erosion on the slopes soon limited its occurrence to the wide, flat ridges known locally as "prairies" and to the areas of second bottom land along the streams, which areas were no doubt former flood plains. The weathering of this material has given rise to the soil mapped as Shelby silt loam.

The drainage water in removing the material washed from the Shelby loam and the Shelby silt loam has carried it into the flood plains of the streams and there assorted it, depositing the sand where the overflow was swiftest, the silt in slowly moving water, and the clay in still water. Later conditions were favorable for the accumulation of organic matter and this material, in addition to the mechanical separation of the mineral particles, has given rise to the three bottomland types, respectively, the Wabash loam, the Wabash silt loam, and the Wabash clay.

The loess has probably formed the bulk of these bottomland types and in many of the wider bottoms the deposit has remained as nearly intact as on the upland, so that really the amount of recent alluvium is comparatively small, except immediately along the bluffs, where the wash from the hills has been enormous, and is rapidly covering the bands of Wabash clay which occur at the foot of the hills.

The soils, then, of Putnam County have all been formed by the redeposition of transported rock flour through the agencies of ice, wind, and water.

The soils and surface geology of Putnam County just described are representative of that part of Missouri lying north of the Missouri River and east of Thompsons Fork of the Grand River. The soils of three counties in this part of the State have been mapped and in each the same, or nearly similar, soil formations have been found. They belong to the great group of glacial and loessial soils of the Mississippi Valley, but as the area over which they have been encountered is small and the different classes of soils few, they have not been placed in a series, but rather given the name of the county in which they were first mapped—Shelby County, Mo. The bottomlands belong to the group of soils occurring in the flood plains of the Mississippi River and its tributaries, and being dark colored are placed in the Wabash series.

The following table gives the names and areas of the several soil types shown on the accompanying map:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Shelby loam	245,184	73.3	Wabash clay	1,728	0.5
Shelby silt loam	48,512	14.5	Total	334,592	.....
Wabash silt loam	27,264	8.1			
Wabash loam	11,904	3.6			

SHELBY LOAM.

The soil of the Shelby loam is a yellow, light to dark gray or brown heavy fine sandy loam or loam with a depth of 5 to 10 inches. There is usually a very distinct line of contact between the soil and subsoil, which is a yellow to reddish-brown sandy clay, becoming heavier with depth until at 36 inches it is a stiff, tenacious clay. Many glacial pebbles and bowlders occur in both soil and subsoil, while lime concretions and calcareous streaks and iron pipes are found in the latter, especially in the lower depths. When the soil is dry it breaks up into aggregations of silt or clay particles, but these crumble easily if rubbed between the fingers. When wet sufficiently to break up this structure the soil loses the properties of a sandy loam and assumes those of a loam or silt loam. The same peculiar structure is also common in the upper subsoil. The subsoil is characterized by pockets of sand, some of which are quite extensive.

There are several phases of the Shelby loam, which in its typical development occupies the slopes toward the water courses. On the crests of the narrow ridges the soil is more silty, approaching somewhat the Shelby silt loam. Along all water courses, where bottom land is not shown on the map, is a narrow deposit of black silt loam to loam 20 to 48 inches in depth. Wherever the channel does not cut this deposit too severely it is a very productive soil, but as it is too limited in extent to be shown on the map as a separate type, it is included as Shelby loam. At the foot of the bluffs along the larger streams there is found another variation, which consists of a deposit of wash from the hills composed usually of fine sand 4 to 24 inches deep. These areas are also too narrow to be shown separately, and are included with the Shelby loam rather than with the Wabash silt loam, which they usually border.

Occupying, as it does, all the gently rolling to rough topography, the Shelby loam is a predominant type, occurring in every section of the county. Unlike the type in Shelby and Scotland counties, where

its occurrence is in mere bands along the water courses, the type here lies in continuous stretches between the comparatively narrow ridges of Shelby silt loam and the bottom lands. The largest unbroken area is in the southeastern part, though the entire eastern half of the county is almost exclusively of this type.

The surface drainage is necessarily good, but in times of heavy rainfall the water runs off so rapidly that serious erosion often results.

As already mentioned, the Shelby loam is undoubtedly the result of weathering, washing, and erosion of the Kansan drift. The most of the silt and clay in the loess, which must have been deposited over the drift, has been carried away in suspension in the drainage waters, leaving the coarser particles. This action has been most pronounced on the slopes, and hence the larger proportion of sand occurring in the steeper areas. The absence or presence of organic matter is of course the cause of the light or dark color, respectively, and probably to this and the clay content is due also its granular structure.

The greater part of this type was originally timbered. The prevailing varieties were white, pin, and black oak, with considerable hickory in some localities. There was also a small percentage of those three species commonly found near the streams—elm, ash, and wild cherry. A little walnut and cottonwood occurred in or near the ravines. Much of the type on the ridges near the Chariton River and the larger creeks was and is yet covered with white oak, almost to the exclusion of other varieties. The soil of these white oak ridges is usually yellow in color and somewhat more friable and easily cultivated than that which was covered with grass or the other varieties of timber. These ridges probably represent those parts of the upland upon which the forest first established itself. The trees in the early days were of large size and completely covered the ground, so that typical forest conditions prevailed. It is an established fact that in this latitude glacial and loessial soils covered with a heavy forest growth do not acquire that high content of organic matter which characterizes virgin prairie soils. Hence these ridges are very deficient in organic matter. In this area the uplands upon which hazel brush and elm prevail are considered superior to the "white oak ridges." The original timber has all been removed and a fair-sized undergrowth now covers the soil in regions abandoned to it.

The Shelby loam is the best soil for oats in the area. It is not a typical corn soil, and yet that crop is needed in the rotation and with proper management yields well. Clover does well under proper conditions, and there is every reason to think that alfalfa and cowpeas would be a success if rightly handled. Areas of the sandy phase at the foot of the bluffs and many of the areas on the slopes are well

adapted to truck or tobacco. Apples are apparently successful. The Ben Davis and Jonathan are the favorite varieties, although Grimes' Golden also does well. The soil is peculiarly well adapted to grasses such as are in general use for pasture land.

Timothy yields from 1 ton to 1½ tons of good quality hay per acre, except on land badly infested with weeds. Corn, if well cultivated, averages 35 bushels per acre, but varies from 10 to 60 bushels under the diverse conditions of culture and season. Oats yield about 35 bushels and wheat about 12 bushels to the acre.

Most of the Shelby loam now cleared lies west of Unionville, and but a small percentage of that is cultivated. Permanent pasture and meadows are the general use to which it is put, but often these are sadly neglected. If given proper care, the same quantity of hay and pasture can be secured from two-thirds, or even one-half, the present acreage, and thus enable the area in cultivated land to be extended. Care is not taken to disk the meadows and pastures, nor to mow the weeds.

The maintenance of organic matter and prevention of washing are the most serious problems in the cultivation of the Shelby loam. It seems that if the first difficulty is met there is but little danger from the second. For this reason not more than two cultivated crops should be grown in succession on this land, and it would be better so to arrange the rotation that one intertillage crop should not follow another. Clover, cowpeas, and alfalfa should be grown as often as possible, and, for a few crops at least, the entire plant should be plowed under. This practice would likely redeem a great deal of the "white oak" land from its present state of relatively low productiveness. Having once incorporated a large amount of organic matter, deep plowing and the maintenance of a rotation which will not tend to deplete it will keep the soil in a very productive condition.

A soil managed as suggested will absorb much rain without washing. Rye is often sown on corn land in the fall and appears, by affording a dense cover crop throughout the winter, to be effective in holding the soil in place. By planting willows or possibly some tree of value for posts, along the draws, washing will also be checked in some places. It is probable that in some of the draws large tile could be placed and covered so that they could be plowed over, and thus reduce to the minimum the washing away of the land. Much of the type, however, would best be left in timber, and some forested tracts were seen which before long will be very valuable.

The type ranges in price from $15 to $40 an acre, depending on location and condition. Areas contiguous to Shelby silt loam with gently rolling topography are considered the best upland soil, while the rough, wooded "white oak" ridge land is held in low esteem.

The type as a rule has the poorest improvements in the county notwithstanding the fact that a great many farmers claim that it is the best soil in the county. Probably such statements refer to silty phases mentioned as occurring on the narrow ridges.

The following table shows the average results of the mechanical analyses of fine-earth samples of the Shelby loam:

Mechanical analyses of Shelby loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15968, 15970	Soil	0.6	3.5	4.9	19.9	10.3	39.8	20.8
15969, 15971	Subsoil	.8	3.3	4.9	32.6	10.5	19.5	28.1

SHELBY SILT LOAM.

The surface soil of the Shelby silt loam, locally known as "flat prairie," is a very uniform silt loam, with a depth of 9 to 10 inches, light to dark gray in color when dry and black when wet. It contains considerable organic matter, is friable and loose, and is easily tilled. At 10 inches and extending to 18 or 20 inches is a crumbly ash-colored material, which when dry is hard and difficult to pulverize, and which contains large numbers of small iron concretions. A sharp line separates this material from the soil and subsoil. To a depth of 36 inches the latter consists of a dark, mottled brown, yellow, and drab silty clay. The upper stratum is tough and hard and, because of its imperviousness to water, is often, though improperly, called hardpan. On exposure it cracks and crumbles readily.

The Shelby silt loam occurs on large second bottoms and on the divides between the streams, the largest areas being on the main divide which passes through the middle of the county. The next most continuous area lies between West Locust and Medicine creeks. The areas between West and East Locust creeks, North and South Blackbird creeks, North Blackbird and Shoal creeks, and Shoal Creek and the Chariton River are very broken and irregular in shape. The largest areas of high second bottom are along the Chariton River, with smaller ones scattered along the several more important creeks. These areas are nearly typical, though the surface soil is often very light colored and contains but little organic matter. A phase of the type with a shallow surface soil and yellowish brown subsurface soil, in which the distinct line of contact with the subsoil does not occur, is found on many of the narrow ridges, but this phase is, as a rule, developed in areas too narrow to be shown on a map of the scale used in this survey.

As a result of its level to gently undulating topography the soil is well drained, except on large level tracts where water may stand for some time after heavy rains. The surface generally is such that cultivation is easy, and only where the stock may have trampled the undrained areas is it difficult to pulverize the clods and secure a good tilth. The soil is supposed to be of loessial origin, and the subsoil is referred either to the Kansan drift or the "gumbo" already mentioned.

The Shelby silt loam was originally covered with prairie grass, which made a very rank growth and tough sod. Some wild grass is still seen growing in neglected spots and along the roadside. The absence of timber on this type is said to be due to prairie fires which destroyed any young tree growth.

The Shelby silt loam is well adapted to oats, timothy, and blue grass, while corn, sorghum, alfalfa, and clover do well on well-drained areas. The following average yields per acre are obtained: Timothy, 1 ton to 2 tons; corn, 25 to 30 bushels; oats, 35 bushels.

Where cultivated, corn is grown on the same land year after year. Probably 85 per cent of the area of the type is in pasture or mowing lands, and is kept so indefinitely. Many pastures and meadows have been so long unplowed and so generally neglected that they yield practically nothing. Conditions would be greatly improved if much of the area occupied by grass should be put into corn and much of the corn land seeded to grass. No fertilizers are used, and, as the stock in most cases runs at large during the greater part of the year, but little manure is saved and spread on the land.

Dry seasons seem to be the chief cause of crop failures on this type. It is obvious that with only about 20 inches of soil in which to conserve the moisture careful methods of cultivation must be practiced to prevent the evaporation of moisture from the surface. It is said that roots very rarely penetrate the hard subsoil, and therefore plants must draw their moisture supply from the soil. Left with a hard, compact surface it does not take long for a soil of the texture of the Shelby silt loam to lose practically all the moisture available to the plants. The keeping of a dust mulch in the corn fields by thorough and constant cultivation and the aiding of rain water to enter the soil of the mowing and pasture land by harrowing the surface occasionally are more than ordinarily important on this type. The capacity of the soil for holding water may be increased by adding organic matter, and more green manuring crops should be plowed under than is customary at present. Tile underdrainage would also assist in improving the moisture conditions and tend to remove the hardpan characteristics in the subsoil.

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

Mechanical analyses of Shelby silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15021, 15972	Soil	0.4	1.7	0.6	0.6	2.7	69.9	24.6
15022, 15973	Subsoil	.4	2.0	1.1	3.3	3.3	56.7	34.3
15023	Lower subsoil.	.1	.9	.4	1.0	2.4	53.9	42.0

WABASH SILT LOAM.

The Wabash silt loam consists of 12 to 15 inches of light to dark gray heavy silt loam. The content of organic matter is everywhere high and the color of the soil when wet is black or very dark brown. It is sticky and tenacious and easily puddled. The subsoil, from 15 to 36 inches, is either a light-colored silt loam, becoming heavier with depth, or a brownish heavy silt loam to silty clay.

This type occurs in all the creek bottoms, in bands varying from one-tenth to three-fourths of a mile wide. The most extensive development of the type is along Medicine Creek, with Locust and Blackbird creeks, Chariton River, and Shoal Creek next in the order named. The soil occupies the first bottoms, and the surface is usually smooth and nearly level, with a gentle slope away from the stream. A great deal of it is overflowed, and as the drainage is slow the fields are often wet until late in the spring. Wide and shallow ditches are used on some of these areas very effectively, and dikes are used in some places to keep the spring floods off the land. Crops on this type stand drought well and, in fact, give the best results in a dry year.

The Wabash silt loam is alluvial in origin and composed of the fine particles of earth removed from the upland consisting of the Shelby silt loam and the Shelby loam.

Originally a heavy growth of oak, birch, elm, hickory, walnut, and cottonwood stood on most of the area occupied by this type, but at present only the stream banks are forested, and here a narrow band of Wabash loam usually occurs.

The Wabash silt loam is the best corn soil of the area; for oats it is not so satisfactory, as the straw grows too rank and lodges. Hay, for the same reason, is apt to be coarse and of inferior quality. Alsike clover does well, and should be more generally grown. Corn is extensively grown in dry seasons, when the ground can be worked, but a great deal of the type is in mowings. Corn yields from 15 to 80 bushels per acre, depending on the precipitation, with an average

of about 45 bushels. Hay yields from 1 ton to 2 tons, and wheat from 10 to 15 bushels per acre.

To obtain the maximum yields from this soil good drainage must first be provided. With this and the use of some good rotation, including corn, alsike or red clover, and possibly wheat, the type should prove very productive and its productiveness should be easily maintained. Mowing lands and pasture should be confined to the upland types. The Wabash silt loam if properly farmed is too valuable in other ways to make its use as pasture permissible. Farmers operating this soil have been very successful. The land now brings $25 to $35 an acre, a much better price than could be obtained even a few years ago.

The following table gives the average results of mechanical analyses of typical samples of the Wabash silt loam:

Mechanical analyses of Wabash silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15976, 15978	Soil	0.2	0.7	0.7	1.9	2.8	63.8	29.7
15977, 15979	Subsoil	.3	1.1	.7	1.4	1.7	51.9	42.8

WABASH LOAM.

The soil of the Wabash loam to a depth of from 12 to 15 inches consists of dark-gray to brown fine sandy loam to loam. It is a loose, easily tilled soil under nearly all conditions. The subsoil from 15 to 36 inches is a loose loam containing considerable fine sand and is usually light brown or gray in color.

The Wabash loam occurs along the streams, and almost exclusively in the eastern drainage system. Shoal Creek bottom is largely made up of this soil, while along Chariton River and the upper courses of North and South Blackbird creeks are found smaller areas. Besides these areas a narrow strip, too small to be shown on the map, has been formed immediately along almost all the streams. In general, the type occupies a position usually somewhat higher than the other lowland types and is often marked with terraces, especially along Chariton River. It is seldom if ever overflowed, and as its structure allows rapid seepage the moisture conditions are decidedly uniform, not being effected materially by wet or dry seasons.

The Wabash loam has been formed from alluvial deposits, its coarser texture as compared to other bottom soils being due to the fact that the streams through these areas have a greater fall than in other parts of their courses and in times of overflow have deposited only

the coarser particles held in suspension. The type is marked by a growth of sugar maples and some birch.

Except the areas which lie next the streams the Wabash loam is almost all under cultivation and is a very popular soil. It is well adapted to corn, oats, wheat, clover, alfalfa, and truck crops.

It yields an average of about 45 bushels of corn, 35 bushels of oats, and 15 bushels of wheat to the acre.

A greater diversification of crops arranged in systematic rotation seems to be the most desirable change in the methods on this type. The content of organic matter must be kept up by means of green manuring crops and barnyard manure to secure best results. Unlike the Wabash silt loam, it does not receive any such materials from overflow deposits at present. Though small in extent it is considered one of the best soils in the county and is commonly held at from $30 to $45 an acre.

The following table gives the results of mechanical analyses of the soil and subsoil of the Wabash loam:

Mechanical analyses of Wabash loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15505	Soil	0.1	0.1	0.2	13.8	15.3	55.3	14.5
15506	Subsoil	.0	.2	.2	20.1	29.6	37.5	12.1

WABASH CLAY.

The Wabash clay, locally called "gumbo," consists of about 8 inches of dark gray to black clay loam or clay, underlain to a depth of 36 inches by a bluish or black clay, somewhat mottled with iron stains. Both soil and subsoil have a very close structure, and if stirred when wet tend to puddle badly and bake and crack on drying. Consequently it is difficult to keep this soil in good physical condition and plowing must be done when the moisture content is just right.

The type occurs only in limited areas, mostly in the Chariton River and Blackbird Creek bottoms. Next to the bluffs and farthest from the stream is usually found a slight depression, and here the Wabash clay is usually developed. The largest area lies in the northeast corner of the county. Most of these depressions, however, were too small to be mapped and there are numerous small patches of this "gumbo" in the Wabash silt loam which are not shown. The type is subject to overflow and water stands upon it for long periods.

The Wabash clay has been formed by the deposition of sediment from standing water, but many areas have been changed considerably

and are likely to be still more influenced by the silt and fine sand washed from the bluffs.

It is said that this soil was originally untimbered and supported only marsh grasses or was entirely covered with water.

Wherever the areas of Wabash clay can be drained it is good corn soil, but at present most of it is in mowings, yielding a large crop of rather coarse hay. By a complete system of shallow open ditches, tile drains, or dikes the greater part of this type could be well drained and crops be made certain. Liming would possibly help the physical condition of the soil by flocculating the particles and thus improving the physical conditions of drainage. When well drained this soil should yield on an average 75 bushels of corn per acre.

The following table gives the results of mechanical analyses of the soil and subsoil of the Wabash clay:

Mechanical analyses of Wabash clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15980	Soil	0.1	0.6	0.6	2.4	1.9	52.9	40.7
15981	Subsoil	.0	.1	.5	5.3	4.3	50.2	39.6

SUMMARY.

Putnam County is one of the northern tier counties of Missouri. It comprises about 523 square miles, or 334,592 acres.

The county lies in the rolling-prairie region of Missouri, and consists of level interstream divides, rough hilly regions along the water courses and bottom lands, the latter lying from 200 to 250 feet below the divides.

There are two drainage systems—one east and one west of the main divide, which runs north and south through the middle of the county.

The area drained by the eastern system is very rough and broken, marked by narrow, irregular ridges, while that of the western is only gently rolling to rolling. The regional drainage is good.

Settlement began in the eastern part of the county about 1836 and gradually pushed westward. Large numbers of settlers came during the decade from 1850 to 1860. At present the total population is about 18,000; rural population 14,000.

Three railroads pass through the county from north to south, giving good shipping facilities. Chicago, Ill., Keokuk and Ottumwa, Iowa, and Kansas City, Mo., are the principal markets.

The mean annual precipitation is about 40 inches, well distributed throughout the growing season. The mean annual temperature is 52° F., and excessive extremes are rare. The growing season is about twenty-five weeks.

The agriculture is based upon stock raising. The small farmers as a rule produce corn and oats and some hay, selling their surplus to local stockmen, who keep almost all of their land in hay and pasture, and plan to buy grain for fattening purposes. Cattle, hogs, horses, and mules of good breeding are raised. There is at present a growing tendency to increase the acreage of the cultivated crops, as it is said the profits from cattle raising are decreasing and it does not pay to keep land in mowings and pasture. Wheat, sorghum, and orchard and truck crops are of secondary importance.

At present no general system of rotation exists. A rotation becoming popular is corn, oats, or wheat and clover, and timothy for four years, making a seven-year rotation.

There is little demand for extra farm labor, and little difficulty in getting all needed for $18 to $24 a month, with board.

No fertilizers are used in the county and as stock is largely on pasture there is very little manure saved.

Five soils were mapped. The Shelby loam, on the rolling upland, is the most extensive. It is formed from glacial drift and is known locally as " white oak land." It is maily in pasture or timber. While some of it is used for corn or oats, it is best adapted to pasture. The type commands from $10 to $45 an acre.

The Shelby silt loam, known as " flat prairie," is a very uniform silt loam with a tough and hard and impervious subsoil, spoken of as hardpan. The type is located on the main divides and is a loessial soil. It is well adapted to oats, timothy, and bluegrass, while corn, sorghum, alfalfa, and clovers do well on well-drained areas. Most of the type is in meadow and corn. Crops on this soil are likely to suffer from drought in seasons of light rainfall, because of the low moisture supply held in the soil and the interference with capillary supply by the impervious stratum in the subsoil. The land sells for $35 to $60 an acre.

The Wabash silt loam occurs in all the creek bottoms, and is an excellent corn soil where the drainage is good. A great deal of the land is overflowed and crops are very uncertain. Land of this type may be purchased for $25 to $35 an acre.

The Wabash loam is confined to terraces and higher levels in the bottoms. It is a well-drained, productive soil, devoted to the growing of corn and wheat. It is valued at $30 to $45 an acre.

The Wabash clay, locally known as gumbo, occupies depressions in the bottom, is poorly drained, and difficult to till. When well drained it is an excellent corn soil.

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