U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE UNIVERSITY OF MISSOURI AGRICULTURAL EXPERIMENT STATION, F. B. MUMFORD, DIRECTOR; M. F. MILLER, IN CHARGE SOIL SURVEY.

SOIL SURVEY OF CHARITON COUNTY, MISSOURI.

BY

W. I. WATKINS, IN CHARGE, AND C. E. DEARDORFF, OF THE U. S. DEPARTMENT OF AGRICULTURE, AND H. H. KRUSEKOPF AND W. DEYOUNG, OF THE UNIVERSITY OF MISSOURI.

THOMAS D. RICE, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1918.]

WASHINGTON:
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., July 29, 1920.

SIR: In the extension of the soil survey in the State of Missouri during the field season of 1918 a survey was undertaken in Chariton County. This work was done in cooperation with the University of Missouri Agricultural Experiment Station.

I have the honor to transmit herewith the manuscript report and map covering this work and to request their publication as advance sheets of Field Operations of the Bureau of Soils for 1918, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. E. T. MEREDITH,
Secretary of Agriculture.

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SOIL SURVEY OF CHARITON COUNTY, MISSOURI.

By W. I. WATKINS, In Charge, and C. E. DEARDORFF, of the U. S. Department of Agriculture, and H. H. KRUSEKOPF and W. DeYOUNG, of the University of Missouri.—Area Inspected by THOMAS D. RICE.

DESCRIPTION OF THE AREA.

Chariton County is situated in the north-central part of the State of Missouri, about 85 miles southeast of Kansas City. Grand River forms its western boundary, and the Missouri River its southern boundary. The included area is 756 square miles, or 483,840 acres.

The topography of the county varies from comparatively level to steeply rolling. A narrow strip bordering the Missouri River bottoms is steeply rolling, but even where the streams have cut deep, narrow valleys, the tops of the hills are not flat nor sharp, but rounded. Just north of the steeply rolling belt and extending in a northeasterly direction, the surface is rolling or undulating, the crests of the ridges being well rounded and the slopes comparatively gentle, the divides become flatter with increasing distance from the river. The rolling part of the county is largely confined to the region south of a line extending from a point north of Prairie Hill to Indian Grove. The territory north of Salt Creek and west of Rothville has almost flat to gently undulating divides, with a general slope toward Grand River. East of this the country is more undulating. A narrow strip of well-dissected land is found along Yellow Creek in the vicinity of Rothville and northward.

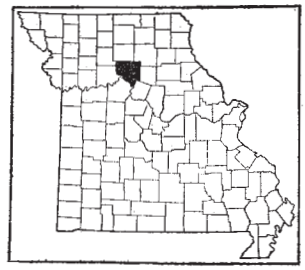

FIG. 1.—Sketch map showing location of the Chariton County area, Missouri.

The roughest areas are encountered east of the main divide and north of Chariton River. The valleys are parallel and are separated by narrow, flat to undulating divides, with rather steep to gentle slopes. The northwest corner of Bee Branch Township is very rugged, with numerous short gullies and sharp divides. That part of Salisbury Township east of the East Fork of Chariton River has rather sharp slopes and is rough. The same is true in the area east of the Middle Fork and north of the Wabash Railroad.

The streams in Chariton County have comparatively wide, flat flood plains, through which they meander sluggishly, often making large loops and forming what are known as "horseshoe" or cut-off lakes. The most important example is Cutoff Lake, southeast of Brunswick, formed by the Missouri River. The sluggish currents

and tortuous courses of the streams cause them to overflow easily. The larger stream bottoms are being drained by cutting straight drainage ditches through the valleys. The Chariton ditch project is the most important one in this county. This ditch is said to carry off the water from the northern part of the county, so that it overflows more often in the southern part. Chariton River and its Middle and East Forks, as well as the smaller streams, follow extremely tortuous courses.

On the whole the county is well drained. Chariton River with its tributaries drains the eastern half, and Grand River the western half. The main divide extends from Indian Grove north to Marceline (Linn County). Only a few short streams flow south into the Missouri from the northern part of Brunswick Township.

The population of Chariton County is reported in the 1920 census as 21,769. It consists principally of descendants of the original settlers. About 10 per cent of the population is colored. The early settlers, principally from Virginia and Kentucky, located along the Missouri, Chariton, and Grand Rivers. These pioneers were interested principally in fur trading. Settlement gradually extended inland, as land was cleared for cultivation.

The most important towns are Salisbury, in the eastern part of the county; Keytesville, in the central part; and Brunswick, in the western part on Grand River. Keytesville, the county seat, has a population of 872; Brunswick, 1,411; and Salisbury, 1,757. There are several smaller towns located on the railroads and in the inland sections.

The county is well supplied with railroads in the southern and western parts. The main line of the Wabash Railroad from St. Louis to Kansas City traverses the county between Salisbury and Brunswick. The Glasgow Branch of the Wabash extends south from Salisbury to Glasgow, where it intersects the Chicago & Alton Railroad. The Omaha Branch of the Wabash leaves the main line at Brunswick and follows the Grand River northward out of the county. The northwestern part of the county is served by the Atchison, Topeka & Santa Fe Railroad, which runs southwest across the county, and the Chicago, Burlington & Quincy which crosses the northwestern township.

On the whole, the county has an excellent system of public roads. Most of them are well graded and are easily traveled except during rainy periods. The roads usually follow section lines.

CLIMATE.

According to the records of the Weather Bureau station at Brunswick, which are doubtless representative of the general climatic conditions of the county, the maximum temperature is 109° F., the

minimum −29° F., and the mean annual temperature 52.5° F. Changes from warm to cold are rather sudden, especially during the winter months. The temperature seldom registers below zero, and then only for a few days. The fall has a prolonged "Indian summer," with bright, clear days and cool, frosty nights.

The average date of the last killing frost in the spring is April 16 and that of the first in the fall October 18. The latest recorded date of killing frost in the spring is May 9 and the earliest in the fall September 29. This gives an average growing season of six months.

The mean annual precipitation of 39.17 inches is well distributed throughout the year, almost one-third of the rainfall occurring during the growing season. Occasionally heavy rainfalls, such as those recorded for the wettest year, cause much damage to crops from the inundation of the bottom lands.

The following table shows the normal monthly, seasonal, and annual temperature and precipitation as recorded at the Weather Bureau station at Brunswick:

Normal monthly, seasonal, and annual temperature and precipitation at Brunswick.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1901).	Total amount for the wettest year (1898).	Snow, average depth.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
December	30.6	71	−22	1.73	1.87	0.85	3.1
January	26.7	74	−21	1.66	1.49	4.05	4.8
February	28.5	74	−29	2.05	1.31	1.96	7.4
Winter	28.6	74	−29	5.44	4.67	6.86	15.3
March	41.1	92	− 1	2.42	3.67	5.89	3.5
April	54.4	97	15	3.28	2.04	3.10	.6
May	64.4	94	26	4.86	1.22	11.88	.1
Spring	53.3	97	− 1	10.56	6.93	20.87	4.2
June	72.8	102	40	5.43	1.43	9.88	.0
July	75.2	109	51	4.73	1.82	3.06	.0
August	73.4	104	44	3.92	1.25	5.15	.0
Summer	73.8	109	40	14.08	4.50	18.09	.0
September	66.1	103	32	4.37	2.04	5.30	.0
October	54.8	93	21	2.80	1.17	6.62	.2
November	41.2	85	3	1.92	.39	2.55	.5
Fall	54.0	103	3	9.09	3.60	14.47	.7
Year	52.5	109	−29	39.17	19.70	60.29	20.2

AGRICULTURE.

The first settlers of Chariton County were trappers and hunters, and interested in agriculture only to the extent of supplying a part of their subsistence. As settlement extended back from the rivers into the interior, however, the variety and volume of agricultural products increased and the real agricultural development of the county began. Among the first important crops were flax and tobacco. The former is not grown at present. Tobacco at one time was the leading cash crop, and in 1879 the total production reached 4,384,924 pounds. Owing to low prices, the large demand the crop makes upon labor, and the shifting of interest to the growing of less exacting crops, production decreased, until in 1912 only 106,072 pounds was produced. In the last few years tobacco growing has become more important, and it promises to approach, if not regain, its former position in the agriculture of the county. General farming and livestock raising have developed gradually from the first, and to-day they are about equal in importance.

Corn is the most important cereal crop. The census reports the production in 1919 of 3,356,107 bushels, or an average of 36.8 bushels per acre on the large area planted. The ground for corn is usually broken in the spring to a depth of 4 to 8 inches and thoroughly worked into condition with harrow and disk. The crop is usually check-rowed or drilled in as soon as danger from frosts is past. Most of the plowing is done with teams drawing 1 or 2 bottom riding plows. On the larger farms the use of small tractors for breaking the land is becoming general, horses or mules still being used for working up the seed bed. The use of tractor cultivators is also being adopted on the larger farms. The principal varieties of corn grown are Boone County White, Johnson County White, Silvermine, and Reids Yellow Dent. Corn is the leading cash crop of the county, although large quantities are used to feed cattle and hogs.

Wheat ranks second in importance among the cereal crops. The census reports show an average yield of wheat of 10 to 17 bushels per acre. In 1918, a very good wheat year, the county averaged 23.6 bushels per acre. One small field produced 52 bushels per acre and several fields of 300 to 700 acres averaged over 30 bushels. The largest yields are obtained on the first and second bottom lands, particularly the Wabash, Waukesha, and Bremer soils. Over 45,000 acres of wheat were sown in the fall of 1918. The 1920 census reports 69,891 acres in wheat with a yield of 1,205,970 bushels. Wheat is seeded from the latter part of September to the latter part of October. The Missouri Agricultural Experiment Station has given October 6 as the date after which there should be little danger from the Hessian fly. The principal varieties of wheat grown are the Pool, Red Cross, Fultz,

and Turkey. The first two are better adapted to the bottom lands, as they have a heavier straw and are less likely to lodge. At present wheat is one of the principal cash crops. Acreage applications of 125 to 200 pounds of fertilizer containing a relatively large proportion of phosphoric acid are sometimes applied for wheat. It is doubtful if this is profitable on the more productive soils.

Oats rank third in importance. The average yield is about 30 bushels per acre. This crop is grown mainly for feed. The principal variety is the Texas Red. Kherson and White Swedish also are important varieties.

Barley, already grown to a small extent, promises to become a rather important crop in the near future.

The most important hay and forage crops are timothy and clover. Clover produces rather well over the entire county, but does best in the southern and western parts. The yield ranges from 1½ to 3 tons per acre. The census shows an increase in the acreage of alfalfa from 30 acres in 1899 to 1,463 acres in 1919. Alfalfa is used as pasture for hogs and is cut for hay. The seasonal yield varies from 2 to 4 tons per acre. Northern seed is used. Alfalfa is particularly adapted to the soils in the southern part of the county and to the loose-structured and friable first and second bottom types. Care is necessary in establishing alfalfa on ground not previously occupied by the crop. Inoculation with soil procured from an old alfalfa field is recommended, and fall sowing ordinarily gives better stands than spring sowing, except on very productive soils.

Kafir and sorghum are grown to a considerable extent for winter feed. Large yields are obtained. These crops are particularly useful on the thinner and more droughty soils, where they produce more feed per acre than corn. Sorghum is also grown for the manufacture of sirup. The best quality is said to be produced on the thin soils in the northeastern corner of the county.

Potatoes and tobacco are important crops. The former is grown for shipping and for local consumption. The early varieties seem to do best. The leaf hopper does considerable damage, but this can be easily overcome. Tobacco, which, as already stated, was at one time the principal cash crop, gradually decreased in importance until recent years, but conditions resulting from the World War have caused tobacco growing to be resumed, and the crop promises to approximate its former prominence. Yields of 500 to 1,500 pounds per acre are obtained. The soils bordering the Missouri River bottoms are particularly adapted to the crop. Fertilizer is not used to any extent. Burley is the principal variety grown.

Fruit growing is not well developed in this county. The majority of the commercial orchards are found in the vicinity of Lewis Mill. The more steeply rolling sections of the hill land bordering the

Missouri River might be used for orcharding, though the steep slopes would make cultivating impracticable and spraying difficult. These soils are said to produce fruit of superior flavor. Apples are the most important fruit, but according to the census reports the number of trees decreased during the decade 1910 to 1920. During the same period the number of peach trees also decreased, and this fruit ranks second in importance. Plums, pears, and cherries are also produced. The number of trees set out is slowly increasing. Such small fruits as strawberries, raspberries, and blackberries are grown for home use, but the quantity produced does not equal the demand.

Hickory nuts, walnuts, and pecans are native to the county. The harvest of the first two is diminishing because of the demand for timber. The pecan trees are left in clearing, the nuts being gathered for the local markets. A small quantity is shipped to the Kansas City and St. Louis markets. Pecans grow principally in the Missouri River bottom lands, and are of excellent quality.

Vegetable crops such as peas, beans, and tomatoes are not grown for the market. Nearly every farmer has a garden just large enough to supply the family needs, but a small surplus reaches the local markets. A larger production of these crops seems worthy of consideration. Onions will do well on some of the Missouri River bottom soils. They give large net returns, but the supply of labor is often inadequate to give the crop sufficient care. Onions are now seldom grown in fields larger than 1 to 3 acres.

The feeding of cattle was at one time a very important industry in the northern and western parts of the county, but it has declined somewhat. The total value of live stock in 1919 amounted to $5,865,196. The feeding cattle generally are grades of the better breeds, though a few are mixed with dairy types. In addition to permanent pastures, the stubble fields after the wheat and oats harvest, the hay fields after the hay harvest, and the stalk fields after the corn has been picked are utilized as pasture. Feeding is usually done in feed lots or sheds, but farmers who feed corn as fodder scatter it over the pastures. Silage and other forage are fed in connection with concentrates, but the amount of the latter is small except in the feeding of beef cattle for market or in the feeding of producing dairy cows.

Practically all the common breeds of hogs are represented in this county. The animals are allowed to run in bluegrass, clover, or alfalfa pastures, and are fed concentrates in addition. Tankage is used rather extensively by the largest feeders.

The sheep industry is not well developed in this county. A total of 21,939 sheep are reported in 1919. The value of the wool sold in that year amounted to $56,402.

The poultry industry is rather important, and is carried on in connection with general farming. Large flocks of chickens, turkeys, and geese of good breeds are found. The sum of $979,567 is reported as the value of poultry products produced in 1919.

Dairying at present is confined to the production of small quantities of dairy products on the general farms, mainly to supply local demand. Some cream is shipped as a surplus from the small herds. Several pure-bred Holstein calves have been brought into the county for the purpose of establishing dairy herds. The value of all dairy products for the year 1919, excluding home use of milk and cream, amounted to $413,759.

Rotation of crops is not given the attention that it deserves. A rotation of corn, oats, wheat, and mixed clover and timothy is most common. Sometimes the wheat crop is omitted. Catch crops are sometimes seeded for pasture.

According to the census, the total number of farms increased from 3,012 in 1880 to 3,426 in 1920, and the area of land in farms from 75.7 to 90.6 per cent of the total area of the county. The average size of the farms in 1920 was 129.9 acres. The largest farms in the county are found in the more fertile southern or western sections, where they ordinarily range in size from 200 to 500 acres. The smaller farms are located in the northeastern part of the county—the section of poorer soils. The percentage of improved land in farms increased from 71 in 1880 to 86.7 in 1920.

About two-thirds of the farms were operated by owners in 1920. Where farms are rented for cash the rental on the best soils ranges from $4 to $7 an acre. Renting, however, is generally on a share basis. The corn crop is usually divided half and half in the crib or shock. In the case of wheat, cowpeas, and oats the landlord receives two-thirds when he furnishes the seed and pays for one-half of the thrashing. If the tenant furnishes the seed and pays for half the thrashing he receives one-half of the crops. If fertilizers are used the landlord may furnish one-half or all. Hay is usually divided half and half in the stack or mow. Special arrangements are made for such crops as cowpeas grown in corn.

The majority of the upland farms in the southern and western parts of the county are highly improved. Small areas of forested land still remain in the hill section bordering the Missouri River bottoms. There are rather large areas of unimproved land in the Chariton River and Grand River bottoms, but these are rapidly being cleared, drained, and either used as pasture or cultivated.

The average value of all property per farm increased from $2,243 in 1880 to $17,294 in 1920. Land values have increased 25 to 50 per cent in the last three or five years.

SOILS.[1]

During the Pleistocene period the northern part of Missouri, as far south as the Missouri River, was overrun by the Kansas ice drift. This glacier brought from the regions of the north a heterogenous mass of rock débris picked up in its progress, and this material, together with much from the local sandstone, limestone, and shale formations, was deposited as drift composed of fine earth mixed with gravel, stones, and bowlders. Upon recession of the glacier the drift sheet formed a vast, smooth plain, but this plain has gradually been eroded until at the present the only remnants left are the flat, narrow divides found in the northern half of the county. As the drainage ways have cut deeper the glacial deposits have been removed and the underlying rock exposed. Since the deposition of the glacial material a thick layer of silty material, commonly known as loess, has been deposited over the entire area. This material is supposed to have been gathered up from the stream valleys or from the plains and laid down in its present position by the wind.

The upland soils have been derived almost entirely from these two classes of transported materials. Differences in color and composition of the soils are due not only to variations in the original material, but probably to a much greater extent to the different conditions under which weathering has taken place and to the unequal periods of time during which its processes have operated.

The loess in its unweathered condition is a fine-grained material composed largely of silt. Its color ranges from light grayish brown to yellowish brown. The material is slightly coherent where undisturbed, but breaks down readily into a loose, floury mass. It washes and gullies rapidly under erosion, but has a tendency to maintain vertical banks which show in many places a columnar structure. Soils of five series have been derived from the loess in this area.

The Grundy series is found on the flat divides where undisturbed weathering has favored the accumulations of black organic matter in the surface soil, the concentration of clay in the subsoil, and a leaching and partial removal of lime from the weathered zone. The soil is dark brown to almost black, and the subsoil a heavy, compact, mottled clay. One type, the silt loam, is developed in Chariton County.

Associated with the Grundy series on the divides is the Edina. The surface of the types in this series is dark brown to black, with a gray, silty subsurface layer and a heavy, plastic, mottled subsoil. The silt loam of this series occurs in Chariton County.

[1] Chariton County adjoins Macon County on its northeast corner. In certain cases the maps of these counties do not appear to agree along the boundaries. This is due to changes in the correlation resulting from a fuller understanding of the soils of the State. The type mapped as Putnam silt loam in Macon County has now been subdivided and a part of it called Edina silt loam. The light-colored part of the soil mapped as Shelby loam in Macon County is now called Lindley silt loam. The Wabash silty clay loam of Macon County has been combined with the Wabash clay in this area.

The Muscatine series is developed on undulating areas below the flat divides. The types correlated in this series have dark-brown soils, an upper subsoil of brown color similar to the Marshall subsoil, and a lower subsoil of brown with gray mottlings.

The Marshall series represents a less advanced stage of weathering and oxidation than the three series that have been described. The surface soils in this series are dark brown and the subsoil a uniform brown in color and friable and open in structure. The Marshall silt loam, the only type mapped in the present survey, occurs in rolling areas, usually on the slopes between the flat divides and the eroded slopes.

The Knox series includes the least weathered and oxidized of the loess soils. Sufficient time has not elapsed for the soil in its present position to accumulate large amounts of organic matter; hence the surface soils are brown with only a slight darkening due to organic matter. The subsoil is light yellowish brown and friable, approaching the character of the original loess. The Knox silt loam, the only type of the series found in Chariton County, occurs on the slopes, usually eroded, bordering the stream valleys.

Two series of upland soils of glacial origin, the Shelby and the Lindley, are developed in Chariton County, and of these the former is the more extensive.

The Shelby series includes types with dark-brown soils, and a yellow to yellowish-brown, sticky, clay subsoil, sandy and gravelly in the lower part.

The types in the Lindley series have light-brown to grayish-brown surface soils, and a subsoil similar to that of the Shelby. As a rule the Lindley soils are more eroded than the Shelby.

The alluvial soils occupy both first and second bottoms; the latter at one time held the same relation to the river as the present flood plain, but since the streams have cut deeper and wider valleys the second bottoms or terraces are now generally above overflow, only some of the lower terraces where they merge into the upland are often indistinct, and as mapped are necessarily more or less arbitrary. In the northern part of the county the soils are usually heavy, and the subsoils compact, and the two types are hardly distinguishable from the adjacent upland soils. The terraces become more distinct in form to the south, and the soils lighter in color, deeper, and more friable. In general, the same relation is found in the terrace soils as in the upland soils, the heavier and more poorly drained soils being found in the north and the better drained ones in the south.

Some of the older terraces in the southern part of the county are composed of loessial material either deposited at the same time the upland loess soils were deposited or laid down by streams from the surrounding upland as reworked loess. These terraces are distinct

at their northern terminus and level, but become higher and undulating as they extend south until they often blend with the surrounding upland at their southern extremity, making the separation difficult. A good example of this is found at Salem Church west of Forest Green.

Five series of terrace soils are recognized. The Chariton series is distinguished by a gray to dark-gray soil, a distinct floury, gray intermediate layer, and a heavy, compact brown to black mottled subsoil. This series corresponds to the Edina series of the upland. The Bremer soils are black, with a heavy, dark-drab to black subsoil sometimes containing iron stains or yellow mottles. The Waukesha series has a dark-brown to black, friable surface soil and a lighter brown, friable but slightly compact subsoil. The Judson series has brown to dark-brown soils with lighter brown subsoils of the same structure and texture, and is distinctly composed of loessial material. The Lintonia soils are also uniform in texture and structure throughout the 3-foot section. They differ from the Judson in color, having light-brown soils and subsoils.

The first bottom soils are divided into three series. The Sarpy and Genesee are similar, both being light brown to brown in color. The Sarpy soils become lighter textured in the lower part of the 3-foot section, but the Genesee is usually heavier here, though there may be sand layers. Both these series are of recent formation and are developed near the larger streams, where the current is swiftest. They were originally forested with bur oak, elm, hickory, cottonwood, and sycamore. The Sarpy soils are mapped mostly along the Missouri River. The third recent alluvial series, the Wabash, includes types with dark-gray to black soils, and plastic, sticky, heavy, black to drab subsoils, mottled with brown or iron stains. It lies immediately along small, sluggish streams, and on the outer edge of the bottoms, next to the upland, along the larger streams. The lighter members of this series were originally forested with oak, hickory, walnut, and elm. On the heavier, lower lying types water oak predominated, although some hickory and pecan were found in the better drained situations. Large areas existed as prairie, supporting a luxuriant growth of coarse wild grass.

In the following pages of this report the soils of Chariton County are described in detail, and their relation to agriculture discussed. The table below gives the name and the actual and relative extent of each:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Shelby loam	65,728	16.4	Edina silt loam	10,880	2.2
Shallow phase	13,760		Judson silt loam	9,024	1.9
Grundy silt loam	78,592	16.2	Lindley silt loam	8,064	1.7
Wabash clay	43,456	12.5	Bremer clay	7,552	1.6
Light-colored phase	16,832		Sarpy fine sandy loam	7,040	1.4
Wabash silt loam	10,432	11.1	Waukesha silt loam	4,672	1.0
Light-colored phase	43,392		Lintonia silt loam	3,328	.7
Knox silt loam	15,488	5.8	Sarpy clay loam	3,328	.7
Heavy-subsoil phase	12,416		Sarpy silt loam	3,264	.7
Bremer silt loam	20,928	4.3	Riverwash	2,880	.6
Marshall silt loam	19,072	3.9	Bremer silty clay loam	2,496	.5
Muscatine silt loam	18,752	3.9	Waukesha loam	704	.1
Genesee silt loam	18,752	3.9			
Lindley loam	18,176	3.7	Total	483,840	
Chariton silt loam	12,992	2.7			
Wabash silty clay loam	8,128	2.5			
Light-colored phase	3,712				

KNOX SILT LOAM.

The soil of the Knox silt loam, to a depth ranging from 10 to 20 inches, is a light to rather dark brown, very friable silt loam. The subsoil is light brown and slightly compact, though friable. Near the river the material is coarser than silt, approaching very fine sand on some of the highest points near Rockford and North Glasgow, but the soil becomes finer grained toward the northern boundary and the subsoil slightly heavier, approaching a silty clay loam. The subsoil here, though rather compact, is still friable.

This is the most extensive loessial soil in the county. It borders the Missouri River bottoms in an almost continuous belt 2 to 5 miles wide, extending from a few miles northwest of Brunswick to the southeastern corner of the county.

The topography of this soil varies from rolling to rugged. The short valleys are rather deep and narrow, as the soil structure resists weathering into wide valleys. Instead of crumbling or sliding on slopes the soil stands in vertical walls. The hills are rounded though rather sharp next to the river. The topography becomes more rounded away from the stream, changing gradually from hilly to undulating.

The Knox silt loam, because of its open structure, is well adapted to fruit trees and to deep rooted field crops, such as alfalfa and clover. It is naturally very productive. By far the greater part of the tobacco is grown on this type, the yields ranging from 800 to 1,500 pounds per acre. It is also well adapted to corn and wheat. Most of the commercial orchards in Chariton County are situated on this soil.

The conditions for bacterial development are very favorable in the Knox silt loam. The soil is normally well supplied with lime, which favors the growing of legumes and the use of a good system of rotation for adding organic matter to the soil. Measures should be taken to prevent erosion, which is likely to be active. The Knox silt loam is one of the most highly prized upland soils, especially where the surface is smooth, and every possible means should be used to keep it in its present productive state.

Knox silt loam, heavy-subsoil phase.—The heavy-subsoil phase of the Knox silt loam has a friable, brown to light grayish brown surface soil, 12 to 18 inches deep. The subsoil is rather heavy, varying from a silty clay loam to a clay loam. Gray mottlings may occur below 20 inches.

The greater part of this phase is found in the vicinity of Brunswick and in the southeast corner of Salisbury Township. Near Brunswick it occurs on eroded slopes and as a thin loessial covering over the "Coal Measures" sandstones and shales, and some small areas derived from these rocks are included. In Salisbury Township the phase is found as a covering over the same materials but with a thin intermediate layer of glacial drift. The change is gradual from the crown of the hill until on the lower slopes purely residual material is encountered, but not in areas sufficiently large to map. To the northward this phase grades toward the Lindley silt loam.

The heavy-subsoil phase is not as productive as the typical Knox silt loam. As mapped in Salisbury Township it is not as well suited to orchard trees or deep-rooted crops, but corn and wheat do well, and excellent pastures are maintained. That part of the phase lying west of Keytesville resembles the typical Knox silt loam more closely than does that in Salisbury Township, and is adapted to the same crops.

This soil is not so highly prized as the typical Knox silt loam. It is valued at $60 an acre and up.

The better areas of this phase will produce good yields of tobacco, alfalfa, clover, and vegetables, and a combination of fruit growing with the grazing of cattle or production of alfalfa would seem to offer opportunities. This soil erodes easily, and care must be taken to prevent damage to the fields, especially where the slope is considerable.

MARSHALL SILT LOAM.

The Marshall silt loam consists of a dark-brown silt loam, 7 to 10 inches deep, which grades into lighter colored silt loam and at 14 to 20 inches passes into a light-brown silt loam or heavy silt loam. Lime concretions occur in the lower subsoil, being more abundant in seepage areas, occurring at the contact between the loess and the underlying compact material.

This type occurs in the south-central and southeastern parts of the county, its irregular areas forming a broad belt extending north of the Wabash Railroad from Triplett to Keytesville, with more scattered areas west of Shannondale to the county line.

The surface varies from undulating to rolling. The hills have smooth, rounded tops, with slopes ranging from gentle to abrupt. Every area has good surface drainage, and the internal drainage and areation are almost ideal.

The Marshall silt loam as a whole is considered one of the very best soils in the State. According to Bulletin 153 of the Missouri Agricultural Experiment Station it is much above the average in plant food. All the general farm crops suited to the upland black prairie soils do well on this type, and it is an ideal corn soil. The average yield of corn is between 30 and 40 bushels per acre, but much higher yields are reported where the best methods of farming are employed. Tobacco, alfalfa, and clover are profitable crops. The farms are as a rule rather large, and farm improvements are above the average for the county.

Rotations including leguminous crops are relied upon to maintain the productiveness of the soil, and there are few other problems connected with its management.

MUSCATINE SILT LOAM.

The Muscatine silt loam occurs north of the Marshall silt loam and may be said to be a transitional type between the Marshall and the Grundy soils. It has formerly been included with the Marshall silt loam and closely resembles that soil in general appearance. The soil is a black or very dark brown silt loam, finer textured than the Marshall and not so open in structure, although friable. At about 12 to 14 inches it grades into a friable brown silt loam extending to 18 to 24 inches, where a silty clay loam mottled with yellow and to a less extent with gray is encountered. Below this the soil section is usually a yellow to brown silty clay mottled with gray and semi-friable in structure. In some areas the material in the lower part of the 3-foot section is compact and hard, such a condition being more common where nearly level areas of the type approach the Grundy soils.

The topography of the Muscatine silt loam is undulating. The surface drainage is excellent except for a few rather low or seepy areas, which represent poorly defined drainage ways with insufficient fall to drain well. The soil here may be easily improved by ditching or tiling. Tile drains are used to advantage in Chariton County, as the internal drainage of the soil is thorough.

Farms on the Muscatine silt loam are highly improved and are valued at $125 to $200 an acre. The productiveness of this soil is

above the average, and by means of a suitable system of crop rotation and manuring can easily be maintained. Wheat probably is better suited to this soil than to the Knox or Marshall. Corn, the most important crop, produces well. Tobacco and alfalfa also do well, but it is harder to get a stand of alfalfa than on the Marshall silt loam. In the eastern part of the county grain farming is the principal type of agriculture, while in the western part a large area is used for pasture. This type is principally prairie, but a sparse tree growth is found on the more rolling areas.

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

Mechanical analyses of Muscatine silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
344843	Soil	0.0	0.8	0.6	1.4	14.9	60.0	21.5
344844	Subsoil	.4	.9	.6	2.2	7.2	61.0	27.7

GRUNDY SILT LOAM.

The Grundy silt loam to a depth of about 12 inches is a silt loam or heavy silt loam, dark brown to dark grayish brown, or almost black when in a wet condition. The upper subsoil, which extends to a depth of 16 to 18 inches, is a grayish-brown or dark-gray heavy silt loam or silty clay loam. The gray color, which is more pronounced than in the soil, may take the form of mottling. This upper subsoil material is underlain by very compact clay loam or clay, dark brown in color, mottled with gray or yellow. Below 30 inches the subsoil in many places becomes less compact and impervious and more thickly mottled with yellow.

The Grundy soils become shallower and the subsoil heavier and more plastic as the distance eastward from Grand River increases. On the divide between the south and the west drainage and on other narrow ridges to the east there is seldom more than 12 to 14 inches of soil above the heavy, compact subsoil. The surface also becomes grayer, with a tendency toward the development of a gray silty subsurface layer. Some small areas near the Shelby soils are shallow and contain an appreciable amount of very fine sand, but, because of the depth of the soil and character of the subsoil, they are included with the Grundy silt loam. This applies particularly to areas in Mendon and Yellow Creek Townships.

The Grundy silt loam is one of the most extensive types in the county. It is the principal soil in Salt Creek and Yellow Creek Townships, the eastern parts of Cunningham and Mendon Town-

ships, and the western parts of Clark and Mussel Fork Townships. One large area lies northeast of Keytesville and another extends northeast from Salisbury for several miles beyond Prairie Hill. Numerous smaller areas occur in the north-central part of the county in narrow strips upon the remnants of divides or in isolated patches. The type occupies the highest divides, which are remnants of the drift and loess covered plain. The size of the areas depends upon the extent to which the streams have cut back into the original surface.

The topography varies from gently undulating to rolling. Surface drainage is adequate, but the internal drainage is not so thorough as in the loess types having more porous subsoils. The Grundy silt loam produces good yields of corn, wheat, and oats. The greater part of the type is used for grain farming. It is not particularly well adapted to alfalfa, owing to the low lime content and the heavy, compact subsoil, but good fields of alfalfa have been established here and there. Clover does fairly well over the greater part of the type.

This land ranges in selling price from $60 to $150 an acre, the greater part of it selling near the higher figure. The lower prices prevail mostly in the northeastern part of the county, and apply to farms including poorly drained spots or eroded areas.

This type on the whole is low in lime, which prevents best results with clover and alfalfa. Ground limestone could be applied with profit over much of its area. Experiments made by the Missouri experiment station show that it responds quite well to the use of soluble phosphates, particularly in growing wheat. The content of organic matter and nitrogen should be maintained by means of crop rotations and manuring. With a proper system of handling, this soil should continue indefinitely to give good results in both live-stock and general farming.

EDINA SILT LOAM.

The Edina silt loam, to a depth of 8 to 12 inches, has a range in color from brown to dark brown or nearly black. The subsurface layer, which is about 8 inches thick, consists of a gray, floury silt loam or heavy silt loam, similar to the intermediate layer of the Putnam soils. It lies abruptly upon a gray or drab and yellow mottled, compact clay. The lower subsoil, is more yellow than the upper and in most places more friable in structure. Here and there the gray subsurface layer is very thin and the type approaches in characteristics the Grundy silt loam. The type as mapped includes areas that have a very compact clay layer, locally known as "hardpan," in the upper subsoil.

The Edina silt loam occurs mainly in the northeastern part of the county, where it occupies long, narrow, irregular strips along the crests of divides separated by the valleys of several tributaries of the Chariton River. Some areas are more than 5 miles long, with a width of less than one-fourth mile. They represent remains of the original plain from which erosion has not as yet removed the loessial covering, although in most places the once nearly level surface has been given a somewhat rolling topography. Surface drainage is fairly good, but the rather impervious subsoil keeps the type saturated, so that as a whole it is considered rather cold and backward in the spring.

A large part of the Edina silt loam is in pasture. The cultivated portion produces fair crops of corn, wheat, and oats. Yields are slightly lower than the average for the Grundy silt loam. The selling price of the land varies from $60 to $80 an acre.

A variation of the Edina silt loam has a soil darker in color and deeper than the average of the type. The color ranges from dark brown to almost black and the texture is a mellow silt loam, resembling the soil of the Grundy silt loam. This soil occupies a number of small patches scattered throughout the Grundy and Muscatine soils. The largest area occurs on the northern border of the county south of Marceline. Several small areas are situated on the divides east of Sumner and north of Mendon. One small but very typical area may be seen 2 miles north of Salisbury.

The type occupies the flattest areas on the divides, and drainage is as a rule somewhat restricted. Ditching or tiling would in most places increase the average productiveness of the soil.

This type has about the same agricultural value as the Grundy silt loam. The same crops are grown, and practically the same yields are obtained.

LINDLEY LOAM.

The soil of the Lindley loam consists of 6 to 8 inches of a grayish-brown to light-brown or brown loam, with areas on the narrow ridges that approximate silt loam. The soil is usually underlain by a yellow loam or clay loam which grades heavier within 2 or 3 inches and passes into a heavy, sticky, yellow clay, with some gray mottlings. When dry the soil is very crumbly. Glacial pebbles occur in the lower part of the 3-foot section. Residual material is exposed on slopes, but never in areas of sufficient size to justify mapping as a separate type.

The Lindley loam is closely associated with the Shelby soils, but as mapped in Chariton County is much more eroded and cut up by drainage ways. Scarcely any of the type has a topography favorable for cultivation. It thus is not first-class farming land, but as a rule it makes very good pasture. Practically all the steep limestone,

shale, and sandstone slopes are included with this type, as they are too narrow to map separately. Some areas of the shallow phase of the Shelby loam also closely resemble this type.

The Lindley loam is most extensive in the northeastern part of the county along Mussel Fork. The largest single area is mapped in the northwestern corner of Bee Branch Township. Most of the type is forested with a sparse growth of white oak and for this reason is locally known as "white-oak land." The improvements are rather poor and roads are inferior.

This soil produces good yields of bluegrass, timothy, and clover, and should be used principally for the production of such grasses. Manure is very beneficial to the soil, and it also responds to lime. The fertilizers recommended for the Shelby loam are good for this soil. General live-stock farming is recommended as the type of agriculture that will likely prove most profitable.

LINDLEY SILT LOAM.

The Lindley silt loam is of little importance because of its small area. The surface soil is a grayish-brown to brown, friable, fine-grained silt loam, passing at about 7 inches into a light or dull brown or medium-brown silty clay loam mottled with gray and grading into rather compact, sticky, plastic clay above 16 inches. This material continues to 36 inches. The same color prevails in the lower part of the 3-foot section, except that it is not so brown.

The Lindley silt loam occupies poorly drained slopes and flats, and is used almost exclusively as pasture land. The inferior grasses common to acid soils predominate. The type would respond to the application of lime and manure, and in the poorly drained areas tiling would be of benefit.

SHELBY LOAM.

The surface soil of the Shelby loam is a dark-brown loam extending to a depth of 9 to 12 inches. Below this is a stratum of 14 to 24 inches thick, underlain by a brown or yellow, rather compact sandy clay, slightly mottled with brown or gray. Sometimes a layer of brown clay is encountered above the yellow clay. In Yellow Creek and Mendon Townships the soil is uniformly several inches deeper than typical, and the brown layer is not encountered. Gravel occurs throughout the 3-foot section. Lime concretions and limestone fragments are often found in the subsoil. Small areas of a silt loam soil are, because of their small extent, included with the loam as mapped.

The Shelby loam is the principal soil type in the north-central part of the county, including Yellow Creek, Clark, Bee Branch, Salt Creek, Mussel Fork, and Cockrell Townships. Other areas are found along the Middle Fork of the Chariton River east and northeast of Salisbury,

and south of Indian Grove. It is more thoroughly drained than the other soils of the county, and the run-off is in many places rapid, causing severe erosion.

The greater part of this type is used as pasture land, although most of the better situated areas are cultivated. The farms are usually small and, except where considerable areas of bottom land are included, are not so well improved as on some of the other types. Corn produces well, but wheat is not so satisfactory. Alfalfa can be grown on this soil, but other legumes find the natural conditions more congenial.

Land of the Shelby loam type is valued at $35 to $75 an acre.

Sheep raising and general live-stock farming are the interests best adapted to this soil. Tests made on it by the Missouri experiment station show that many of the areas need lime and that the type responds almost universally to soluble phosphates, particularly when these are applied to wheat followed by clover. At normal prices of potash small applications of this material can often be made with profit. The rolling nature of the land calls for great care in the prevention of erosion. The soil is well suited to bluegrass and timothy, and the more rolling areas should remain in grass.

Shelby loam, shallow phase.—The shallow phase of the Shelby loam is confined to the more eroded and steeper slopes. The surface soil appears dark brown, spotted with brown. The soil in most places is only 2 to 6 inches deep, and underlain immediately or within 12 inches by a layer, 2 or 3 inches thick, of reddish-brown and gray mottled clay loam. This passes into clay of the same color, the material becoming yellow in the lower part of the 3-foot section. The brown layer is often absent, and in some of the more eroded parts the subsurface clay loam stratum also is lacking, the clay coming to the surface.

The greater part of this phase is used as pasture land, only some of the better areas being cultivated. Low yields are usually obtained. The improvements are fairly good. The selling price of the land varies from $30 to $50 an acre.

The same methods of soil management should be adopted for this phase as are recommended for the typical Shelby loam. Most of the type should be used for pasture.

BREMER SILT LOAM.

The surface soil of the Bremer silt loam is a dark-brown to black, heavy silt loam, ordinarily ranging in depth from 15 to 18 inches, but in places extending to 28 inches. The subsoil is a dark-brown silty clay loam, which changes gradually into a gray or drab, sticky, plastic clay, mottled in the lower part with iron stains.

A few small, poorly drained areas have an imperfectly developed dark-gray layer between the soil and subsoil, as, for example, in the area lying between Reo and Coleman Schools, a few miles northwest of Salisbury.

The Bremer silt loam is the most extensive of the terrace soils. It occurs over the western and southern parts of the county along the Grand and Missouri Rivers, with several scattered areas along the larger tributaries of these rivers, and one lies along the Chariton River a few miles northwest of Salisbury.

The type has a flat topography and imperfect drainage. That drainage was originally very much restricted, as indicated by the mottled subsoil. This is the terrace soil that corresponds in color, structure, and origin to the Wabash of the first bottom. At the present time the greater part of this soil is above the limit of overflow, but part of it is flooded at extremely high stages of the river. Crops are often injured by poor drainage. Ditching or tiling is necessary in many areas to bring this soil to its highest productiveness. Fortunately its elevated position makes drainage practicable throughout the type.

The Bremer silt loam is considered one of the most valuable soils in the county. Large yields of corn, wheat, and oats are obtained. Some of the legumes do well, though the deep-rooted legumes, such as alfalfa, require better drained soils. The greater part of the type is used for grain farming, the crops being sold rather than fed.

The farmers on this type are above the average in equipment and improvements. The selling price of the land ranges from $125 to $175 an acre.

BREMER SILTY CLAY LOAM.

The soil of the Bremer silty clay loam consists of two layers, an upper one of black heavy silt loam, 2 inches thick, and a lower one of black silty clay loam which extends to depths ranging from 8 to 18 inches. The subsoil also has an upper and lower horizon—the former a drab, sticky, tenacious clay and the latter of similar texture, but drab mottled with brown color. The surface soil is mellow and easily worked when moisture conditions are favorable, but when too wet it is very sticky. The principal deficiency of the type is its poor drainage which is due to the impervious subsoil. This condition, however, may be improved by tiling.

This type occurs in several areas in association with the Bremer silt loam. The two largest lie south of Whitham. Several typical areas lie along Chariton River several miles northwest of Salisbury.

The Bremer silty clay loam was formerly used only for pasture, but the high price of grain during the last few years has resulted in the growing of wheat and corn. Crops are retarded and sometimes destroyed in wet springs, but the average crop is profitable.

BREMER CLAY.

The soil of the Bremer clay is a black, waxy, sticky clay, with a surface covering of 1 to 3 inches of silty clay. At about 16 inches the soil grades into a dark-drab, sticky, plastic clay. The drab color may become more pronounced with depth, and in places mottled with brown iron stains.

The largest area of this soil is found at Whitham. Other areas extend along the Wabash Railroad near Brunswick and Dalton. Owing to the flat surface, ditching or tiling is necessary. In favorable years the soil is very productive, but it does not produce so well in wet years. It has a high natural productiveness and is rich in organic matter, but its heavy, sticky nature makes it difficult to handle. Wheat, corn, and oats are well adapted to this soil. Bluegrass, timothy, and clover are good hay crops.

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

Mechanical analyses of Bremer clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
344819	Soil	0.1	1.6	2.1	10.1	13.7	44.8	27.6
344820	Subsoil	.1	2.0	3.0	9.0	12.1	44.5	29.4

CHARITON SILT LOAM.

The surface soil of the Chariton silt loam ranges in color from a dark-gray to black, friable silt loam, varying in depth from 6 to 14 inches The subsurface layer is a decidedly loose, rather floury, gray silt loam. Brown iron stains are often found in this gray section. At 16 to 26 inches a compact, heavy, brown or black clay, mottled with gray or drab, is encountered. Yellow mottling sometimes appears in the lower part of the 3-foot section.

The Chariton silt loam is found on the terraces of the major streams. The largest area is situated east of the Chariton River and north of Salisbury.

The surface of this soil is flat, and the poor drainage has been remedied in places by ditching. Internal drainage also is poor, and in wet seasons crops do not yield well. Information gathered from farmers indicates that good results are obtained from tile drains where the interval between them is not too great. On the more elevated parts of the type drainage is better and the gray subsurface layer is not so well developed.

The greater part of this type is in cultivation. Corn, wheat, and oats are grown successfully. Grasses do well, particularly acid-

tolerant varieties. The farms are well improved, and valued at prices only a little lower than the Bremer silt loam. This soil responds to the application of lime, manure, and phosphates. The chief difficulty in its management is draining and maintaining the organic-matter content. Ordinarily large areas are kept in grasses.

JUDSON SILT LOAM.

The soil of the Judson silt loam consists of a dark-brown or almost black silt loam from 10 to 14 inches deep. The subsoil is a brown silt loam grading into a friable silty clay loam at a depth of 28 to 30 inches. It is an essential characteristic of this type that no very marked change of texture takes place within the 3-foot section. Faint-gray mottlings may appear in the lower part of the section, but this is exceptional. The surface black silt loam is deeper on the terraces in the southern part of the county. The outer margins of the areas of this type—that is, the margins away from the stream—are usually colluvial and slope toward the upland, so that boundaries between this and the upland types, such as the Grundy silt loam, are very difficult to determine. A problem of this kind was met in mapping the area in the vicinity of Salem Church in Chariton Township.

The strip mapped west of Coleman School in Salisbury Township varies from typical, in that the surface soil has a lighter color and the subsoil is slightly heavier in texture, with distinct gray mottlings. As it resembled the Judson silt loam more nearly than the Bremer silt loam, it was decided to include it with the former.

The Judson silt loam occupies numerous areas mainly in the southern part of the county. The larger bodies of the type lie east of Triplett along Salt Creek, southeast of Keytesville, on Puzzle Creek, and around Forest Green, on Little Chariton River.

This soil is composed of reworked loessial material. In some places it is a true terrace formation; in others, it consists of colluvial wash from the adjacent hills. In either case it is composed of loessial material that has been transported only a short distance and modified so little that it does not differ greatly from the upland loessial types, particularly the Marshall soils. In average years there is no marked difference in productiveness between the true terrace and the colluvial slopes, but in dry seasons better yields are obtained on the colluvial soil along the foot of the slopes.

The Judson silt loam is adapted to the same crops as the Marshall silt loam. It is a typical corn soil, and this is the important crop. Alfalfa and all the deep-rooted crops should do well on this soil if properly seeded. The farms on the Judson silt loam are well improved, and most of the type is cultivated. It is valued at $150 to over $200 an acre.

Originally this soil was covered with a growth of very large walnut, hickory, elm, ash, and other hardwood trees.

Small, poorly drained areas of less than 1 acre occur in this type. They have rather grayish brown soils, with heavy, compact subsoils. They are rendered productive by heavy applications of barnyard manure, and by tiling and ditching. Where large enough to map separately they are classed with the Chariton silt loam.

LINTONIA SILT LOAM.

The soil of the Lintonia silt loam is a brown to light-brown silt loam, about 15 to 18 inches in depth. The subsoil is lighter brown, and at 28 inches becomes a friable silty clay loam without any further change of color, except that gray mottlings appear in places in the lower part of the 3-foot section. This is not a usual characteristic of the type.

The Lintonia silt loam occupies the same topographic positions as the Judson silt loam and differs from it only in the lighter color of the surface soil. A narrow rim of Lintonia silt loam usually occurs on the outer, more uneven edge of the Judson terraces, and this soil is normally more droughty than the colluvial wash found at the foot of the upland slopes occupied by the Knox silt loam. Some of the narrow, high bottoms in the Knox belt are included in the Lintonia silt loam. They uniformly have darker surface soils and heavier subsoils than the Lintonia areas on the broad terraces.

The Lintonia silt loam is not developed in large areas, but it is considered an excellent soil. All the areas with favorable topography are in cultivation and productive, the slopes and small stream terraces giving best yields. Such crops as alfalfa, clover, and fruits are particularly adapted to this soil. The system of soil management applicable to the Marshall and the Judson soils is recommended for this type also. The surface soil is slightly deficient in organic matter, and soil improvement should begin with the plowing under of green manure crops, preferably the legumes.

WAUKESHA LOAM.

The Waukesha loam consists of dark-brown loam, 18 inches deep, underlain by brown, friable loam extending to depths greater than 36 inches. The sand content of both soil and subsoil is mainly of the finer grades. The subsoil is slightly heavier in texture than the soil, and usually has a somewhat compact structure, but it is never heavy enough to be considered a clay loam.

This type occurs in long, narrow areas in the Missouri alluvial lands. The largest is mapped near Cazzell. Several small bodies of the type lie southeast of Brunswick.

The Waukesha loam occurs on a terrace lying well above the present limit of overflow. The drainage is almost ideal; the soil is retentive of moisture, but underdrainage is good and crops do not suffer in seasons of excessive rainfall.

The crops grown successfully on the Waukesha silt loam also do well on this type. Yields are nearly the same, and the land has the same high agricultural value.

WAUKESHA SILT LOAM.

The Waukesha silt loam, to an average depth of 18 inches, is a dark-brown silt loam, friable, and easily worked. The subsoil is slightly heavier in texture, ranging from a heavy silt loam to a silty clay loam. The upper subsoil is dark brown, but it changes downward into brown. The subsoil is open in structure and allows good underdrainage.

This type occurs in the Missouri River bottoms just south of Dalton. It is confined to one large area and a number of small outlying areas, covering in all several square miles. The type occupies a topographic position below the Judson silt loam; for this reason it has a larger supply of moisture, and crops withstand drought for a longer period. The topography is nearly level, but drainage is perfect.

The Waukesha silt loam is regarded as the best soil in the county in point of productiveness, ranking somewhat higher in this respect than the Marshall or Judson soils. It is especially suited to corn, and the average yield of this crop is high. Wheat, oats, and all other crops commonly grown on the black prairie soils do well. The price of this land ranges from $150 to $200 an acre.

WABASH SILT LOAM.

The soil of the Wabash silt loam is a black silt loam to heavy silt loam, the color being due to a high percentage of organic matter. At depths of 12 to 24 inches this grades into a black, sticky, silty clay and at lower depths, into a heavy clay of the same color and texture. A drab-colored clay, containing brown iron stains, is ordinarily encountered before a depth of 30 inches is reached, and in some places it lies within 12 inches of the surface.

The largest areas of this type are found in the Grand River, Chariton River, and Missouri River bottoms. It occupies the higher parts of the bottoms and is also found as colluvial outwash at the openings of small draws where the soil has been deposited as the water loses its force upon entering a wider valley. These outwash fans usually contain more sand, and are deeper and loamier. They commonly occur adjacent to the Shelby areas, and a gray subsoil is usually developed in these situations. The Wabash soil mapped at the heads of small drainage ways in areas of the Shelby soils is modified by colluvial

material from the surrounding slopes. In the last two situations mentioned the soil is better drained than the greater part of the type, but it forms only a small proportion of the total area.

This is one of the most important of the bottom soils. Despite the inadequacy of the drainage, it is the best drained of the Wabash soils. It is used extensively for both pasture and cultivated crops, but owing to its position it is subject to frequent overflows and the loss of crops. In some places this type has been tiled and drained. Its selling price varies widely, depending mainly upon the frequency of overflow. Some of the largest yields of corn, wheat, and oats in the county are obtained on this soil.

Wabash silt loam, light-colored phase.—The light-colored phase of the Wabash silt loam is found in the more poorly drained situations. The surface soil is a dark-gray to black silt loam to depths varying from 9 to 15 inches, where a drab or black silty clay loam is encountered. This grades into a drab, brownish-drab, or brown clay. Brown iron stains are common throughout the 3-foot section, and in some instances they occur in large numbers, the material in such places having a more friable and crumbly structure. In most places the type has a sticky, plastic subsoil. Occasionally there is a rather distinct, gray subsurface layer varying in thickness and depth.

The boundary between the light-colored phase and the typical Wabash silt loam is arbitrary. Each soil includes areas of the other. Small areas and strips of Genesee silt loam occurring along the minor drainage ways also are included in the light-colored phase. One area in Cunningham and Mendon Townships southwest of the Crum School has a decidedly gray, ashy, silty surface soil and a gray, plastic clay subsoil mottled with brown.

The Wabash silt loam, light-colored phase, is probably more variable in agricultural value than any other in the county. Most of it is used for pasture, but a large percentage is cultivated and produces well in favorable seasons. The soil is very fertile. The chief drawback to its use is the frequency of overflow. Attempts to improve this condition include the building of levees and the digging of ditches to drain off the excess water in wet years.

Land of the Wabash silt loam, light-colored phase, is valued at $40 an acre and up.

WABASH SILTY CLAY LOAM.

The surface soil of the Wabash silty clay loam, to a depth of 10 inches, is a black, sticky, slightly waxy silty clay loam, grading into a black, sticky clay. At 16 to 20 inches there is encountered a drab, sticky, waxy clay, which extends to 36 inches. Brown iron stains occur in the drab portion of the soil section. Those areas in which the borings show a drab color at 24 inches and below are usually lighter textured and better drained.

The Wabash silty clay loam is found along the larger streams. It is usually situated between the Wabash silt loam and the upland soils, or in the large bends of the creeks where the current is slow and has allowed the finer particles to settle. It is found chiefly along Chariton and Grand Rivers. The largest area mapped is south of Cunningham, in Cunningham Township. The soil here was probably deposited by the current of Grand River and Yellow Creek coming together when in overflow, the decrease in velocity allowing the finer particles to settle.

Like all the other Wabash soils, this type is very fertile and produces excellent yields of corn, wheat, and grasses, but it is difficult to handle because of its heavy texture and lack of drainage. Tiling and drainage would probably improve most of the type. Its selling price, like that of all the Wabash soils, has a wide range depending upon the drainage.

Wabash silty clay loam, light-colored phase.—In mapping, it is difficult to separate the light-colored phase from the typical Wabash silty clay loam. It occurs in small, isolated areas throughout the bottom lands of the county, the largest areas occurring along Yellow and Elk Creeks.

The surface soil varies from a dark-gray to black, heavy silt loam, grading within 2 or 3 inches into a silty clay loam of the same range in color. At 10 to 14 inches the subsoil becomes drab or gray, and at depths ranging from 18 to 26 inches a gray or drab clay is encountered. The entire 3-foot section may contain brown mottlings or iron stains. These are usually more numerous below 12 to 15 inches. Small areas scattered throughout this phase have a brown soil and approach in characteristics the Genesee silt loam, but these were not separated owing to their relatively small extent.

As a whole the light-colored phase does not produce as well as the typical silty clay loam. The drainage is poorer, and the need for surface ditches or tiling urgent. In most places strong levees are required to prevent overflows. The greater part of the type is in bluegrass pasture.

WABASH CLAY.

The Wabash clay consists of a dark-gray, black, or brownish-black, sticky, tenacious and rather compact clay soil, grading at 15 to 24 inches into a subsoil of dark-drab clay of the same general characteristics, the color changing the lower part of the 3-foot section to drab or gray. Brown mottlings or iron stains may occur throughout the soil section, but are not always found in the lower part. Some of the forest areas in pasture have a distinctly gray surface soil, but cultivated fields have a darker surface color, as a result of aeration and oxidation. The same color difference arises when the gray areas are drained.

The Wabash clay, locally known as "gumbo," occurs in the lower parts of the bottoms. As the streams overflow they build what is known as a natural levee. This leaves a low area between the front lands and the upland. During the high waters that part of the flood plain nearest the hills often overflows first, and water stands on it longest. As there is scarcely any current here, very fine clay particles are deposited.

As a whole the Wabash clay is of recent formation. Several inches of sediment are sometimes left at a single overflow. The type is high in organic matter, and very productive. The areas are flat and the surface drainage poor, while the heavy texture and compact structure of the materials retard internal drainage. Ditching and tiling have given good results. Large areas of the Wabash clay are leveed.

This soil produces as much as 40 bushels of wheat per acre, and in favorable seasons it gives large yields of corn and oats. Grasses grow abundantly, and large areas were formerly used as pasture in conjunction with stock raising on upland farms. Coarse water-loving grasses originally covered most of the type, but these have given place to bluegrass, except in the more poorly drained parts. Pin oak is the only tree found upon this type.

The Wabash clay is very difficult to handle. When wet it is sticky and plastic, and when dry it bakes and cracks easily. Cracks 4 inches wide and 3 feet deep have been noticed in this soil. When wheat is to follow wheat or oats a good plan is to break the ground early and allow it to weather. The alternate wetting and drying cause it to crumble, and it can then be pulverized with a disk harrow.

The selling value of the Wabash clay varies from $20 to $100 an acre, depending upon the improvements and location.

Wabash clay, light-colored phase.—The surface soil of the Wabash clay, light-colored phase, is much lighter in color than that of the typical Wabash clay, being grayish brown to dark grayish brown rather than dark brown or black. It includes the variations between the Wabash and the Genesee soils. The texture varies from silty clay loam to clay. Iron stains often give the soil a brown-mottled appearance. At depths of 7 to 10 inches the soil is underlain by a drab and brown or gray and brown, mottled clay, which extends to a depth of more than 36 inches. Iron stains and iron accumulations add to the mottled appearance in many places. Over a part of the area of this phase a relatively large proportion of silt gives the lower subsoil a friable and porous nature. These characteristics seem to be better developed where abundant iron accumulations appear in the subsoil.

This soil occurs along nearly all the larger streams, in areas that vary greatly in size and shape. Large areas border Chariton River to a short distance from its mouth. These have a darker brown

color than the other areas, are higher in silt, and have a more open structure. They are not classed locally with the "gumbo" soils. The areas along Grand River have dark-gray or dark grayish brown soils and drab subsoils similar to those of the typical Wabash clay.

This phase, like the typical Wabash clay, is a rich soil, very productive where drainage and protection from floods are provided. Corn and wheat are the principal crops, and large yields are obtained when conditions are favorable.

SARPY FINE SANDY LOAM.

The Sarpy fine sandy loam is a brown to light-brown fine to very fine sandy loam containing a relatively large proportion of silt and underlain by a brown or grayish-brown fine sand at depths varying from 24 to 30 inches. Because of its position and open, porous subsoil this type is well adapted to the deep-rooted crops, such as alfalfa and clover.

The Sarpy fine sandy loam occurs chiefly in the Missouri River bottoms and in small areas along Grand River. It has been deposited by the swift overflow currents of the river, and so is situated closest to the stream. The largest area is that at Aholt, in the extreme southern part of the county.

The topography is billowy to flat. The type is not overflowed so often as the heavier types, the water recedes from it sooner, and the open, porous soil and subsoil result in more rapid drying. As a result this is one of the first soils to be cultivated in the spring or after rains.

The type is very productive and is easily tilled. The one drawback to its utilization is the frequency of overflows. It is valuable as a trucking soil. It is naturally drought resisting, and produced medium yields of corn in 1918 when the crop on other soils failed. Land of this type is held at prices ranging from $60 to $150 an acre.

SARPY SILT LOAM.

The Sarpy silt loam, to a depth of 15 inches, is a brown silt loam, except in depressed areas, where drainage conditions are not perfect, in which case the lower part of the soil is grayish brown. The upper subsoil consists of a layer of heavy silt loam or silty clay loam, and this is underlain at 24 to 30 inches by loose, friable silt loam, which rests on a stratum of brown or grayish-brown sand extending to depths greater than 3 feet.

The type is variable throughout the 3-foot section, as it has been built up of deposits of various grades and kinds of material, deposited under differing conditions existing during different floods. The layers may not occur in the order given above, but this is the more

common arrangement. In places heavy clay layers are found in the sandy subsoil and in places the sand may come quite near the surface.

The Sarpy silt loam occurs in numerous small areas scattered over the Missouri flood plain, in which it has about the same topographic position as the Sarpy fine sandy loam. In some areas it has been formed where the fine sandy loam has been covered by a layer of silt loam.

Yields of the general farm crops, particularly corn, are slightly higher on this type than on the Sarpy fine sandy loam.

SARPY CLAY LOAM.

The soil of the Sarpy clay loam, to depths ranging from 12 to 15 inches, is a grayish-brown to brown light clay or heavy silty clay loam. At about 15 to 20 inches it becomes a brown silt, and in the lower part of the 3-foot section a light-brown silt, mottled with gray and very friable. At 30 to 40 inches a brown very fine sand is encountered. This layer of sand allows good internal drainage.

The Sarpy clay is the lowest lying of the Sarpy soils. It occurs mostly in old stream channels where water stands after overflows, allowing the clay particles to settle out. Like the other Sarpy soils it is very fertile, and general farm crops do well in favorable seasons.

GENESEE SILT LOAM.

The soil of the Genesee silt loam varies from a silt loam to a very fine sandy loam, brown or light brown in color. At depths ranging from 9 to 20 inches this surface layer grades into a heavy silt or silty clay loam subsoil in color brown mottled with gray, and extending to 36 inches or more. Thin strata of sand are in many places encountered in the lower part of the 3-foot section. Soil of loam or fine sand texture ordinarily occurs along the stream and in sharp bends, but not in areas large enough to map.

The Genesee silt loam lies along Chariton and Grand Rivers and some of the smaller streams. It is situated close to the streams, and in bends where swift currents have deposited the coarser materials. It has relatively the same color and position as the Sarpy soils.

The surface is rather billowy and eroded by flood waters. In the lower situations the soil is heavier textured and grayish brown and in the higher ones, lighter textured and brown.

This type produced some good yields of corn in 1918, giving about the same yields as the Sarpy soils. It is retentive of moisture and resistant to drought, but crops are damaged during rainy periods.

RIVERWASH.

The term Riverwash is applied to the recent alluvium constituting river bars and levees along the Missouri River. In this area the

material is composed principally of sand. Riverwash is not a permanent soil. Most of it is inundated when the river rises and the material changes with each overflow. The flats are either bare or covered with a growth of willow. None of the type has any agricultural value at the present time.

SUMMARY.

Chariton County, Mo., situated in the north-central part of the State, adjoining the Missouri River, has an area of 756 square miles, or 483,840 acres. The upland consists of an eroded plain bordered on the south and west side by broad belts of alluvial land. The upland ranges from undulating to sharply rolling and consists mainly of long ridges separated by nearly parallel valleys. The stream valleys are broad and flat and consist of the flood plains of the large streams now subject to overflow and of terraces standing at various levels above the streams and above the limit of high water.

The county is well supplied with public roads, which usually follow section lines. It has good transportation facilities, being traversed by the lines of three large railroad systems furnishing direct communication with Kansas City and St. Louis.

Keytesville, the county seat, Salisbury, and Brunswick are the most important towns and constitute local markets.

General farming, in combination with stock raising, is the principal type of agriculture. Corn, wheat, and oats are the leading crops. Barley, hay, and forage crops are grown to a considerable extent. The acreage of alfalfa is small but is increasing.

The soils of this county are of loessial, glacial, or alluvial origin. Loessial soils cover the greater part of the upland. In this group five silt loams are mapped, representing different stages of weathering in the loess.

The Knox silt loam is the least weathered. The soil is brown and the subsoil is a light yellowish brown, friable silt loam. This soil occurs near the streams, and the surface is usually quite rolling. The Marshall silt loam is a dark-brown soil with a brown, friable silt loam subsoil. The Muscatine silt loam is similar to the Marshall except that the lower subsoil is slightly mottled. The Edina silt loam has a dark-brown to black soil, with a gray silty subsurface layer and a heavy, plastic, mottled subsoil. The Grundy silt loam is found on the flat divides. It has a dark-brown soil and a heavy gray and yellow mottled, compact clay subsoil.

Two series of upland soils are of glacial origin. Neither of these is very extensive. The glacial soils occur on slopes and are usually very much eroded. The Shelby soils are dark brown, with yellow to yellowish-brown, sticky clay subsoils, containing sand and gravel in

the lower part. The Lindley series has light-brown to grayish-brown surface soils, with subsoils similar to those of the Shelby.

The alluvial soils may be divided into first and second bottom types. Five series, including eight types, are correlated on the second bottoms or terraces. Four of these, the Bremer, Waukesha, Chariton, and Judson, have dark-brown to brown soils and do not differ greatly in agricultural value. The Lintonia silt loam has a light-brown soil and a light-brown, friable subsoil.

The first-bottom soils are grouped in three series. The Sarpy and Genesee are similar in color, having light-brown to brown soils with light-brown subsoils. The Sarpy soils have lighter textured subsoils than the Genesee. The Wabash soils have dark-gray to black surface soils, with heavy, drab or mottled gray and brown subsoils.

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[PUBLIC RESOLUTION—No. 9.]

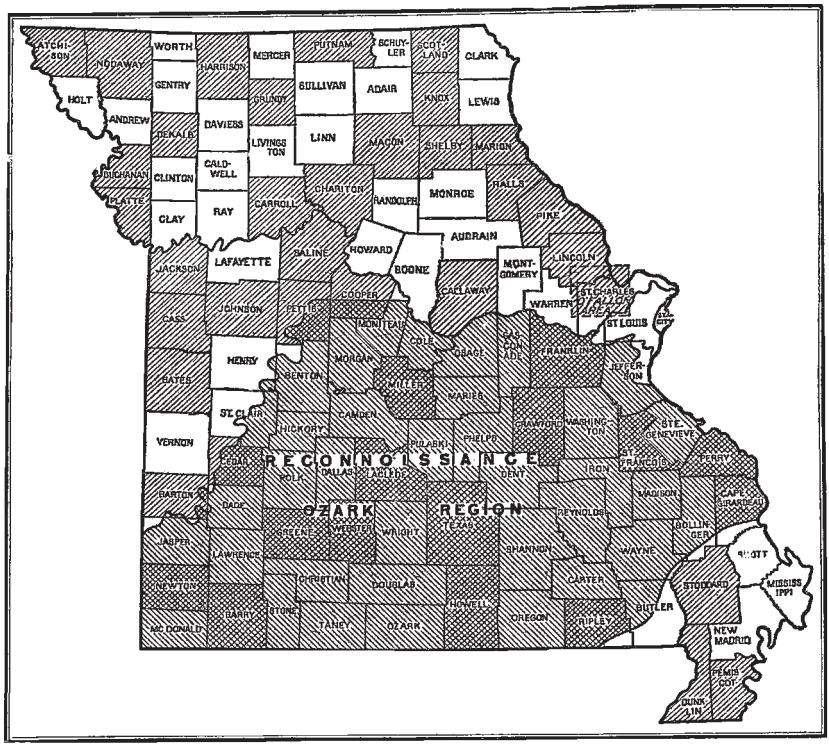
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Areas surveyed in Missouri.

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