

Issued February 14, 1914.

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

SOIL SURVEY OF CASS COUNTY,
MISSOURI.

BY

H. H. KRUSEKOPF, OF THE UNIVERSITY OF MISSOURI, AND
FLOYD S. BUCHER, OF THE U. S. DEPARTMENT
OF AGRICULTURE.

HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1912.]



WASHINGTON:
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., August 15, 1913.

SIR: The soil survey work in Missouri is being carried on in cooperation with the University of Missouri Agricultural Experiment Station. One of the projects completed under this cooperative agreement during the year 1912 was the survey of Cass County. The selection of this area was made after due conference with Dr. F. B. Mumford, director of the Experiment Station.

I have the honor to transmit herewith the manuscript and map covering this work and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1912, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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MAP.
Soil map, Cass County sheet, Missouri.

SOIL SURVEY OF CASS COUNTY, MISSOURI.

By H. H. KRUSEKOPF, of the University of Missouri, and FLOYD S. BUCHER, of the United States Department of Agriculture.

DESCRIPTION OF THE AREA.

Cass County is located on the western boundary, midway between the northern and southern boundaries of the State of Missouri, and it is within a few miles of the geographical center of the United States. It is bordered on the north by Jackson County, on the east by Johnson and Henry Counties, on the south by Bates County, and on the west by Johnson and Miami Counties, Kans. The county has

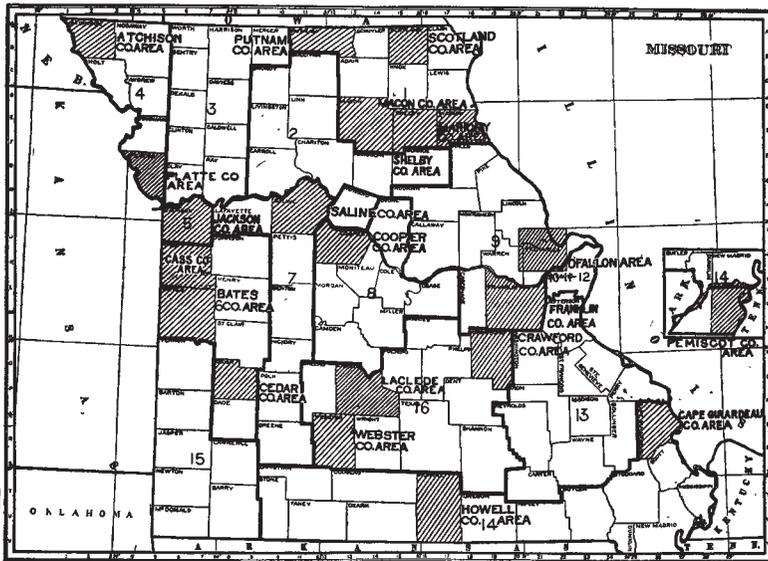


FIG. 1.—Sketch map showing areas surveyed in Missouri.

an average width of 27 miles and is nearly square. It contains 712 square miles, or 455,680 acres.

Cass County is situated entirely within the soil province known as the Great Plains Region. The surface configuration of the county is dominantly undulating to gently rolling, with occasional ridges and hills, usually not more than 50 to 75 feet in elevation, and with broad, flat bottoms along the larger streams. The features of the

region clearly indicate the geological structure and relative resistance to erosion of the interbedded shales, limestones, and sandstones composing the basal rocks of the region. The latter are nearly horizontal, yet dip gently northwestward, without pronounced folding or faulting. Higher rocks outcrop successively in the direction of the bedding slope. The strike of the strata is about due northeast and southwest. Except for an occasional limestone knoll or low ridge the extensive shale horizons are characterized by level or undulating topography, which gives way to a more rolling relief where the underlying limestone has been exposed. Only along the streams in the limestone region is the topography broken and rough.

The effect of erosion on the rock strata has resulted in the formation of three rather indistinct terracelike topographic divisions or platforms within the county. The lower platform or division includes all of the southeastern half of the county and has an average altitude of 900 feet. The intermediate division includes all the remainder of the survey except the northwestern corner of the county, which includes the highest platform. The average elevation of the middle platform is about 1,000 feet and of the highest about 1,100 feet above sea level. The lower and intermediate divisions are about equal in extent and represent about 99 per cent of the total area of the county. The border between these divisions extends from a point 3 miles west of the northeast corner of the county, southwest to Pleasant Hill, thence slightly southwest to Harrisonville, and then 6 miles west, where it turns abruptly toward the south, leaving the county south of Main City. The border varies from a rather wide, gentle slope to a narrow, steep slope, almost blufflike in places. Northeast from Harrisonville it is marked by a distinct "set-off," 30 to 50 feet in height, but in the southern part of the county, where erosion is active, the escarpment is ragged and faintly developed. It is not regular, but makes deep embayments wherever cut by streams.

The eastern border of the higher platform extends from a point on the county line north of Raymore southward to that village, thence southwestward to the western boundary of the county near Jaudon. It corresponds topographically with the border separating the lower and intermediate platforms.

The lower platform is a flat to very gently rolling plain sloping southeastward. South and southwest of Creighton the surface is slightly broken. Occasional isolated hills or mounds having elevations of 50 to 75 feet above the surrounding country are another feature of this plain.

The intermediate division is gently rolling, but along its eastern border is dissected by deep valleys of streams flowing from it into the lower division. Westward and northwestward from the eastern

border the valleys become more shallow, until along the northern border of the platform the surface is gently undulating.

Only the eastern edge of the higher division is in Cass County. It is only moderately dissected and has a gently undulating surface.

These three topographic divisions are not confined to Cass County, but are widespread features characterizing the topography of a large part of western Missouri and are coextensive with the surface exposure of the rocks on which they are developed.

Nearly all the drainage of Cass County is carried by the Grand River, which rises near Belton and flows southeastward, leaving the county in the southeast corner. It forms the southern boundary of the county for a distance of 13 miles. Lick Branch, Sugar, Eight Mile, Tennessee, and Black Creeks and South and East Grand Rivers, all rising within the county, are the main tributaries of the Grand River. The northeastern part of the county is drained by Big Creek and Crawford Branch, which enter the county from the north and cross the eastern boundary near Gunn City. All these streams empty into the Osage River, and through it drain into the Missouri River. The extreme northwestern corner of the county drains northward through tributaries of the Big Blue River.

The channel of Grand River is about 18 feet below the level of the flood plain. It has a very irregular course, but in general follows the southern bluff. Frequently it overflows its banks and spreads over the whole valley, making the reclamation of this large area of land a difficult matter.

The forested areas of the county have always been confined to the immediate vicinity of the streams or to small areas of hill land in the southwestern part of the survey. The prairies originally supported a rank growth of prairie grasses, and when these became dry in autumn they burned, so that the young trees were unable to gain a foothold. Along the streams, in the bottom and in more rugged areas, as well as where greater dampness prevailed, the fires have been less destructive. These strips constitute about the only areas which were ever forested. At present the tree growth is confined to the neighborhood of creek bottoms or to areas of land unfit for cultivation. The principal trees are black oak, elm, hickory, walnut, red oak, white oak, ash, and cherry. The timber is used for posts and fuel.

In 1849 Cass County was formed from a part of Van Buren County, which had been organized in 1835. It was named in honor of Gen. Lewis Cass. The first white settlement in the county was made in 1828. The early settlers selected lands near the streams and forested areas, principally along Big Creek and the headwaters of Grand River. In 1833 there were perhaps 75 to 100 families in the county.

The 1850 census gives the population as 6,090; in 1860 it had increased to 9,794, and in 1870 to 19,296; in 1910 it is given as 22,973.

Harrisonville, the county seat, founded in 1837, has a population of about 1,950. Four railroads intersect at this point. Pleasant Hill, the largest town in the county, with a population of 2,065, is also an important railroad center. Extensive greenhouses located here supply the Kansas City market with cut flowers. Belton, Raymore, Peculiar, Strasburg, East Lynne, Freeman, Garden City, Creighton, Archie, Drexel, Lisle, and West Line are other towns in the county, each of which is located on a railroad and supported by agricultural industries.

The railroad facilities are good. Every part of the county is reached by the Missouri Pacific, including Joplin division, the Missouri, Kansas & Texas, the Kansas City Southern, the Frisco, the Kansas City, Clinton & Springfield, and the Chicago, Rock Island & Pacific Railways. Excepting St. Louis and Jackson Counties, there are more miles of railroad in Cass County than any other county in the State. The northern boundary of the county is only 20 miles from Kansas City, and direct connections with St. Louis, 260 miles distant, are secured over the Missouri Pacific and Chicago, Rock Island & Pacific Railways.

The wagon roads, as a rule, are good, but a more extensive use of the road drag is recommended. The large quantities of limestone rock in the county should be more widely used in the building of macadamized roads. The county is supplied with an excellent system of rural mail routes and telephone lines.

Nearly the entire population is engaged in agricultural pursuits, and appearances indicate a general degree of prosperity not exceeded anywhere in the State. However, the building of better barns for the housing of live stock and farm machinery would in many cases prove profitable. According to the census of 1910, 92.1 per cent of the land area is in farms, and 88.3 per cent of the farm land is improved. There are few counties in the State that have less nonagricultural land than Cass County. Few farms exchange hands. In the last decade the average size of the farms has increased from 127 to 130 acres, and the number of tenants has decreased, with a proportionate increase in the number of land owners. About one-third of the farms are operated by tenants. The average value of the farms in Cass County is about \$11,000.

The agricultural practices have had time to adjust themselves, so that present methods are probably the most profitable and practical under existing conditions. The people are assuming a stability in methods of living and quality of improvements characteristic of a long-settled community. No other county in the State possesses more

favorable conditions for agriculture, considered either from a social or economic standpoint, than does Cass County.

CLIMATE.

The climate of Cass County is essentially the same as that of all western Missouri, and closely corresponds with the average for the State. The mean annual temperature is 53.1 F. as compared with 53.4 F. for the State, and the mean annual precipitation is 37.88 inches as compared with 39.17 inches for the State.

The fall of the year is characterized by long periods of mild, pleasant weather. The winters are short and mild, and zero weather is rare before the 1st of January. Extremely cold weather seldom continues for more than three days at a time. The annual snowfall, from an average of 10 years, is 20.6 inches. There is seldom more than a 6-inch fall at one time. The late frosts which occur in April and sometimes in May frequently damage fruit trees. Occasionally warm spells in winter start the buds, and subsequent freezes are disastrous. The heat of the summer is usually tempered by southwest breezes.

The average date of the last killing frost in the spring estimated for a period of 19 years at Harrisonville is April 19, and of the first killing frost in the fall, October 26. The latest date of killing frost in the spring recorded during this period is May 28 and the earliest date in the fall September 28. The average growing season of 190 days is sufficiently long for the maturing of all crops grown in the county.

The precipitation is well distributed throughout the year, but is greatest during the summer months. Short periods of drought, from 4 to 6 weeks, usually in August and September, are common, but are withstood by the soil when proper cultural methods are used.

The data in the table below compiled from the records of the Weather Bureau station at Harrisonville represent approximately the climatic conditions of the county. The precipitation averages are for a period of 44 years, and the temperature averages for 15 years.

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

Month.	Temperature.				Precipitation.				
	Average for a period of 15 years.			Mean, 1912.	Average for a period of 44 years.			Total, 1912.	Number days with 0.01 inch or over (average for 15 years).
	Mean.	Absolute maximum.	Absolute minimum.		Mean.	Total for driest year.	Total for wettest year.		
	° F.	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.	Days.
December.....	31.3	68	-16	34	1.85	0.44	1.02	2.70	6
January.....	27.0	70	-16	16	1.58	1.15	0.45	0.90	7
February.....	29.1	81	-28	27	2.10	1.25	3.40	1.89	6
Winter.....	29.1	.....	.....	26	5.53	2.84	4.87	5.49	19
March.....	40.2	92	1	31	2.49	0.87	3.44	7.53	8
April.....	54.0	96	15	56	3.58	2.05	7.41	4.60	9
May.....	63.8	93	25	69	4.96	2.60	4.64	2.25	12
Spring.....	52.7	.....	.....	52	11.03	5.52	15.49	14.38	29
June.....	73.2	104	41	70	4.66	2.18	12.16	8.52	12
July.....	77.4	112	52	80	4.01	3.52	10.66	1.95	9
August.....	75.0	108	50	78	4.14	5.27	6.45	4.46	8
Summer.....	75.2	.....	.....	76	12.81	10.97	29.27	14.93	29
September.....	68.2	103	29	67	4.12	1.26	8.09	1.93	8
October.....	56.0	95	21	60	2.39	2.09	0.74	2.23	6
November.....	41.7	79	4	44	2.00	1.57	0.04	0.33	6
Fall.....	55.3	.....	.....	57	8.51	4.92	8.87	4.49	20
Year.....	53.1	112	-28	53	37.88	24.75	58.50	39.29	97

AGRICULTURE.

Cass County is equaled by few other counties in the State of Missouri in having such a large percentage of first-class farming land, in the nearness of large markets, and in the large number of railroads offering excellent shipping facilities. These advantages, together with the excellence of the soil and the ease with which it is handled, combine to make Cass County a leading agricultural section.

The early agriculture of the county consisted mainly of the growing of corn and wheat and the raising of cattle. Oats, rye, and flax were grown on a small scale, and some attention was given to the production of tobacco and cotton. These industries had a steady growth until the closing years of the Civil War, when agricultural progress was interrupted, largely by the virtual depopulation of the county. After the war, however, the county was rapidly settled again, most of the settlers coming from Illinois and Iowa. Shortly after

1870 about one-fourth of the land was improved, and such land could be bought for \$8 to \$25 an acre. Land prices advanced rapidly, but in 1874-75 suffered a decline of 30 to 50 per cent on account of excessive taxation for railroad building, the cessation of immigration, and crop failures, due to the ravages of grasshoppers. During succeeding years much damage was done by chinch bugs, but each time the agricultural practices were so modified that the cause and effect of the insect pests were soon overcome. With the appearance of the chinch bugs the wheat acreage was decreased, but it again increased when the bugs became less numerous.

The county comprised an extensive range, so that it was quite natural that stock raising should early become an important industry. The cattle were raised and largely fattened on the range, although, since it was difficult to market the corn raised in the county, this crop was used mainly for feed. With the advent of the railroads the industry grew rapidly. The production of cotton and tobacco was abandoned, and only grain crops were grown.

Corn is the most important crop, both in acreage and in value. It was grown in 1911 on 125,815 acres, or about 29 per cent of the total area of the county. The average annual yield is between $2\frac{1}{2}$ and 3 million bushels.

Most of the grain is used for feeding the live stock, only a very small amount being shipped out of the county. Some of the corn is cut and shocked, but the greater part of the crop is either husked or snapped without being husked and the stalks left standing in the fields. A greater appreciation of the food value of corn stover and the growing of more small grain will probably bring about a change in this practice and more corn will be cut and shocked.

Both white and yellow corn are grown, but the former predominates. According to experiments conducted by the Missouri Agricultural Experiment Station, Boone County White and Commercial White for white corn and Reids Yellow Dent and Leaming for yellow corn, are the varieties best suited to this region. The seed is either check-rowed, drilled, or listed. Because of less thorough cultivation the practice of drilling should be discouraged. Listing should not be practiced where the land slopes sufficiently to permit washing. Smooth cultivation is recommended in preference to ridged cultivation. More attention should be given to the proper selection, housing, and testing of the seed corn, for by this means the quality and yield can be greatly improved.

Next to corn, wheat is the most important cultivated crop. The total area devoted to wheat in 1911 was 18,910 acres, with an average yield of 16 bushels per acre, or a total yield of 302,560 bushels. Maximum yields of 36 bushels are reported. Fultz, Poole, Fulcaster, Mediterranean, Bluestem, and Golden Bronze are varieties well

suiting to this region. Occasionally damage is done by chinch bugs and the Hessian fly, but this can be avoided to a certain extent by late sowing and thorough cultivation. Infested fields should have all the rubbish, stalks, etc., destroyed or burned, so that the insects may have no place to hibernate. With a thorough preparation of the seed bed, and more care in selecting and cleaning the seed, the yield can undoubtedly be increased. Wheat is not as important a crop as it should be. The silt loam soils with heavy subsoils are well adapted to the crop. Moreover, it is needed to fill out a well-balanced rotation. The continued growing of corn has so decreased the fertility of many fields that a system of rotation is imperative, and wheat, as the most profitable of the small grains, should form an important crop in the rotation. The use of commercial fertilizers in the growing of wheat is receiving some attention. Fertilized fields yield, it is said, from 3 to 9 bushels more per acre than the unfertilized. A complete mixture containing nitrogen, phosphorus, and potassium is generally used, but it is probable that a phosphate fertilizer alone would be most profitable if used in conjunction with barnyard or green manure; and a systematic rotation of crops.

Oats are a secondary crop in Cass County, and the acreage varies from year to year. In 1910 the total acreage was 17,275 as compared with 12,506 acres in 1911. The yields, too, are variable, and range from almost complete crop failures to 50 or 60 bushels, depending on the season. Spring oats are grown almost exclusively. Siberian, Wideawake, Jeanette, Martinsburg, Texas Red Rust Proof, and Kherson are the best adapted varieties. The importance of sowing the seed as early in the spring as possible can not be urged too strongly, for the plants thrive best during the cooler weather of early summer. Very little of this crop is exported, most of it being used as horse feed. To help fill out the rotation and as a nurse crop for clover, oats should continue to be an important crop.

Rye is a crop of no economic importance in this county. Occasionally a small patch is sown to serve as pasture or as a cover crop. It is admirably adapted for these two purposes, and its use could be extended with profit. A small patch of kafir is grown on nearly every farm, being used as a forage crop, the average yield of fodder being about 3 tons per acre. The acreage varies with the season and is greatest in dry years, when the crop supplies an abundance of supplementary feed. Kafir is either drilled in rows like corn or broadcasted. In the latter case it is not cultivated.

More or less sorghum is grown for the manufacture of molasses for home consumption; 200 gallons per acre is considered an average yield. The best quality of molasses is produced on the Bates soils.

Flax was at one time an important crop in Cass County, but at the present time the total area devoted to flax is probably less than 1,000

acres. It is grown for the seed only, and 9 bushels per acre is considered a good yield. Flax is an excellent nurse crop for clover and timothy, as its foliage is not dense enough completely to shade the ground. Castor beans, once a secondary crop, are no longer grown.

Alfalfa is a crop of minor importance, only a little more than 1,000 acres being devoted to its production. It is grown principally on the limestone and lighter shale soils in the northwestern part of the county, and does exceedingly well. Four cuttings are usually made each year, with a yield of 2 to 4 tons per acre. Alfalfa will thrive on all the red or limestone soils, and on the lighter soils of the Summit series. It is doubtful if alfalfa will do well on the heavier Summit soils, since the crop does not flourish where there is a heavy subsoil. It is suited to the lighter alluvial silt loams of the stream valleys, if they are well drained. It will thrive on any deep, fertile, well-drained soil with an open subsoil. To secure a good stand, thorough preparation of the seed bed is essential, and an application of well-rotted manure is beneficial, especially on the poorer soils. It is necessary to use clean seed and to suppress the growth of weeds and grass by cultivating the alfalfa after the second or third cutting with either a disk or spring-tooth harrow,

Red clover is grown in every part of the county, but not on a very extensive scale. The acreage varies from year to year, depending largely on the climatic conditions. All of the soils in the county are well suited to the crop and a stand can be secured with little difficulty. With the decreasing productiveness of the land the value of clover as a soil renovator is being more fully appreciated and its acreage is increasing. The clover is sown with wheat or oats in the spring and cut for hay the second year. Sometimes the crop is plowed under in the fall of the first year as a green manure. This is a good practice and should be adopted more generally. Since it does so well over the entire county, clover should be grown on every farm, not only as a hay crop, but as a legume to supply the soil with nitrogen and organic matter. Very little clover seed is produced, although this industry would probably prove profitable.

Japan clover grows in many of the older pastures, but its value in the pasture seems not to be fully appreciated. More effort should be made to establish this clover, particularly on lands which are not cultivated. On some of the poorly drained creek bottoms and on the flat uplands, where it is difficult to get a stand of red clover, alsike should be grown, since it thrives on soils which are too sour and wet for red clover.

All of the common tame grasses do exceedingly well in Cass County, the heavy silt loams being especially adapted to timothy and bluegrass. Yields of the former are 1 to 3 tons per acre, and the hay

is of high quality. The pastures consist almost exclusively of bluegrass, which spreads over uncultivated fields in two or three years.

The importance of cowpeas as a soil renovator and as a forage crop has not as yet been fully appreciated by the farmers of Cass County. Since clover thrives in this county the need of growing cowpeas is not so apparent. Besides being an excellent substitute where there is a failure to secure a stand of clover, the cowpea is in itself a crop of exceptional merit. The crop does remarkably well on all the soils of the survey, yielding from 1 to 3 tons of very nutritious hay per acre, and improves the soil, whether grazed, cut, or turned under. Occasionally a crop turned under green would be of benefit, particularly in case of the heavier soils and those deficient in organic matter. Besides improving the land physically cowpeas are almost as effective as clover in increasing its fertility. They can be broadcasted or drilled at the time of last cultivation or planted in the hill with corn. When planted alone a good method is to drill the seed with a grain drill, using 4 to 5 pecks to the acre. Seeding should not be done until two or three weeks after corn-planting time and when the ground is thoroughly warmed. The Whippoorwill, Clay, Black, and New Era varieties are recommended.

The early settlers of Cass County grew tobacco in a more or less desultory manner, but at the time of the Civil War this industry was entirely abandoned. During the last few years an effort has been made to revive the industry, and results have been promising. A total area of several hundred acres was devoted to the crop in 1911. This acreage was confined to the northwestern part of the county. White Burley is grown almost exclusively, and yields range from 1,200 to 1,800 pounds per acre. With the prevailing prices of the last few years, tobacco growing has been profitable. It is grown on the heavy Summit silt loam, but in all probability would do better on the limestone or red soils. Growing tobacco on a few acres on each farm could be made an important adjunct in the prevailing type of farming, and agricultural and economic conditions warrant the extension of the industry, but tobacco production will never take the place of grain and stock raising. The county is favorably located with respect to large tobacco factories, and the soils are adapted to the crop. These conditions, together with the prevailing prices and the demand for greater diversity in the farm practices, should all combine to make tobacco growing profitable.

The fruit-growing industry is not developed on a commercial scale in any part of the county. On most of the farms there is a small apple orchard and occasionally a few peach, pear, and cherry trees. During the more favorable seasons a small amount of fruit is sold, but ordinarily most of it is grown for home consumption. It is probable that the red limestone and the brown Summit soils are the best

fruit soils in the county. Owing to the late spring frosts it is not probable that fruit growing will ever be developed commercially.

The trucking industry has not been extensively developed at any point in the county, though small patches of strawberries, tomatoes, onions, melons, etc., do well in all parts of the survey. The well-drained red limestone soils are best suited to truck crops.

In the production of live stock Cass County is one of the most prominent in the State. This is largely due to the extensive area of excellent pasture land and to the abundant grain crops. As a source of revenue the live-stock industry holds first place. The value of domestic animals in Cass County is given in the 1910 census as \$4,531,184. A total of 35,913 cattle, 18,771 horses, 4,476 mules, 82,809 hogs, and 19,890 sheep is reported.

A large number of cattle are raised each year, and in addition "feeders" are brought into the county to be prepared for market. The quality of the cattle is good, and pure-bred herds representing all the leading beef breeds are found. Hog raising is carried on in conjunction with cattle raising, and is a source of revenue on every farm. Small flocks of sheep are found in all parts of the county, and it is probable that their number could be increased with profit. Each year large numbers of western sheep are brought into the county to be fed for market.

The raising of horses and mules is another important industry, and although no single farm is devoted entirely to this branch of animal husbandry a large number of farmers have a few horses and mules for sale each year. The young animals are sold when 1 or 2 years old, and always find a ready market because of their high quality.

The dairy industry is growing steadily. At the present time dairying is most popular in the northwestern part of the county, around Belton and Raymore. Few farmers make a specialty of dairying, but there are many farms on which 10 to 15 milch cows are kept. Both milk and cream are exported. This industry should be more extensively developed, since it is remunerative and is also a good means of building up the fertility of the land. Good markets and excellent shipping facilities are already available.

The type of agriculture now practiced in Cass County and the crops grown are well adapted to the soils and the general conditions of this region. The agriculture of the county will always be based on the growing of corn and grass in conjunction with stock raising. It is probable, however, that farming will become more diversified.

In general, the soils of the county are in fair physical condition, yet in many places the continuous growing of corn, or corn and wheat, with the burning of the stalks and possibly the wheat straw, is impairing the physical condition. The soil is becoming more compact

and difficult to work, and aeration, granulation, absorption, and moisture movement are interfered with. This condition of poor tilth is becoming very serious on many farms and is one of the factors that limit the crop yield.

The remedy is to increase the organic matter content by plowing under such crop residue as cornstalks, straw, clover, etc., instead of selling or burning it, as is often practiced now. The stalks should be cut up and turned under, and the straw should be returned to the land in some practical way, either directly or in manure. Clover should be one of the crops grown in the rotation, and it should be plowed under directly or in manure. The necessity of applying organic matter is obvious. It is upon the humus supply more than upon any other one factor that the productiveness of a soil depends. The live-stock farmer can maintain the humus content of the land by the use of manures, while the grain farmer must depend more upon the growing of special crops, such as clover and cowpeas, for turning under. Every rotation should include leguminous crops.

The cultural methods practiced in the county are good. Frequent shallow cultivation is recommended for the heavier soils. Many fields could be improved by tile drainage.

Commercial fertilizers are not used, but it is probable that in many cases the use of a phosphatic fertilizer would be profitable. The carrier may be bone meal, acid phosphate, or rock phosphate. The potash supply in the soil is fairly abundant, and when the humus supply is built up sufficient quantities of this element will be available for maximum yields. On all soils that are acid, 2,000 pounds per acre of ground limestone should be applied every four or five years. The limestone is best applied after plowing for wheat or oats, allowing the subsequent preparation of the seed bed to work it into the soil. Rock phosphate should be plowed under with farm manures, clover, or other green manures.

It is probable that in the future the acreage of wheat will be greatly enlarged. The heavy silt loam soils of the county are not only admirably adapted to wheat, but this crop is the most profitable to include in a well-balanced rotation. An increased acreage in wheat will also mean an increased acreage of clover. In order to secure a greater diversity of crops and give employment during the winter months, it is probable that the tobacco-growing industry will be greatly extended.

While in general this region is not adapted to commercial fruit growing, it is suggested that more attention be given to the establishment of small orchards. On every farm there should be a few trees of the different kinds of fruit, sufficient at least to provide for home consumption. In all parts of the county the growing of truck crops for home consumption could be profitably extended.

Since the county is favorably located with regard to markets, is well supplied with good shipping facilities, and is admirably adapted to dairying, it is recommended that this already important industry be still further developed.

The average size of the 3,251 farms in the county is 130.8 acres. Land rent varies from \$2 to \$8 an acre, depending on location and quality of the land. Where the land is leased on shares from one-third to one-half of the crop is reserved as rent. According to the census of 1910, the average value of land an acre is \$60. Prices range from \$50 to \$135. The majority of sales are made at about \$100 an acre.

SOILS.

Cass County is within the west Missouri residual plains region. The upland soils are the direct product of the weathering of the local rocks, and therefore their distribution and character are determined by the situation of these underlying rocks. The rocks consist of interbedded strata of limestone, shale, and sandstone, of the Pennsylvanian division of the Carboniferous, and dip slightly to the north and west. Outcrops at the surface are in zones having a northeast and southwest trend. The upper or more recently deposited beds are found in the northwestern part of the county, while the oldest or lowest beds are encountered in the southeastern part. The higher of these beds has been most important in the formation of the soils. The lower beds outcrop along the larger streams and their tributaries, so that the area of each soil depends directly upon the topography and extent of the drainage systems.

The shale beds vary from a few feet to 150 and 300 feet in thickness. They range in color from light yellow or grayish yellow to drab. The shale is soft and micaceous, and breaks down very readily. The beds are rarely seen, except where protected by overlying strata of limestone, or where cut by streams or roads.

The several limestone beds that enter into the formation of soil in this county are quite uniform in character, are chert free, and vary in thickness from 1 to 20 feet. They withstand erosion more persistently than the softer shale, and wherever they appear at the surface or are dissected by streams the surface is rough. The thickest limestone beds occur in the central part of the survey, and mark the escarpment along the eastern edge of the intermediate platform.

The various rocks are disintegrated to depths of 1 to 60 feet, the greater depth of the soil mantle occurring where the softer shales are exposed. None of the soil types encountered can be said to be derived from any one of the formations exclusively, as all the formations above have contributed more or less material to the soil. Each formation originally extended farther east, and has been worn

back to its present position, leaving some of its decomposition products scattered over the surface.

The upland soils may be divided broadly into three groups, based on origin. The Crawford soils, characterized by the red color of the subsoils or soils, or both, are derived primarily from limestone. The Summit soils are characterized by the black color of the material, which is derived from shale and limestone, the former having contributed the bulk of the material. The Bates soils represent the decomposition products of shale and sandstone, the latter contributing a rather unimportant part of the material. The surface soils are brownish, while the subsoils are typically mottled yellowish and reddish.

The alluvial soils are all derived from the upland soils of this county and of the adjoining county when the streams rise there. Wash from the Summit silt loam constitutes a very large part of this material. Only one series, the Osage, is developed to a sufficient extent to be recognized. These soils consist of dark-colored plastic clay or silty clay.

The following table gives the name and extent of the various soil types found in the county:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Summit silt loam.....	248,128	60.1	Crawford stony clay loam.....	7,168	1.6
Friable subsoil phase.....	25,792		Oswego silt loam.....	4,032	.9
Crawford silt loam.....	79,040	17.3	Summit stony clay loam.....	3,712	.8
Osage silt loam.....	60,608	13.3	Bates loam.....	3,392	.7
Bates silt loam.....	15,744	3.5			
Osage clay.....	8,064	1.8	Total.....	455,680	.....

SUMMIT SILT LOAM.

The Summit silt loam is the most important soil type in the county, comprising more than 50 per cent of the total area. In its typical development it consists of a very dark gray or black, mellow silt loam to a depth of 12 or 15 inches, underlain by a black, crumbly silty clay loam, which at about 18 to 20 inches grades into a dark-drab to black clay of a plastic, waxy, sticky character. Below about 30 inches the subsoil is usually mottled with yellowish brown, greenish yellow, or lighter shades of brown. The gradation from the soil into the sub-surface section is almost imperceptible, but the change from the sub-surface soil to the heavy clay subsoil is rather sudden. In places the subsoil is dark brown in the upper portion, and lighter brown or yellowish brown below, while in other locations the color of the sub-soil is nearly black to a depth of 3 feet, the latter condition being

confined usually to the poorer drained and lower situations, while the former condition is encountered generally on the better drained areas. The boundary between the variations based on these differences is in general marked by the escarpment representing the eastern edge of the intermediate platform or topographic division extending in a general way from the northeastern to the southwestern corner of the county. The type as found on the intermediate platform has a black or very dark gray clay subsoil. In the southeastern half of the county the type has a lighter colored subsurface soil, and a clay subsoil which is yellowish or greenish, tinged with gray. Iron concretions are occasionally found in both soil and subsoil, while fragments of chert frequently occur in exposures of the substratum, which is nearly always a yellow or grayish-yellow, heavy, plastic clay.

A peculiar characteristic of this soil is that it does not puddle readily. Wherever the subsoil is exposed, as in stream cuts or along roads, it has a granular structure, and breaks up into cubical soil aggregates or granules. The result of this structure is that the soil does not easily run together, bake, or crack. On account of the heavy subsoil the type is not very drought resistant. To eliminate this disadvantage as much as possible, frequent shallow cultivation is necessary, especially during the late summer months.

The Summit silt loam occupies nearly flat to undulating and gently rolling country, the average topography being considered more uneven than that of the Oswego silt loam, which this type closely resembles in color, texture, and structure. The surface drainage is good. The streams and draws flow through shallow valleys, and the level of the plain is rarely more than 20 or 40 feet above the valley bottom. The entire extent of the type therefore is available for easy cultivation. The depth of the soil mantle is great, frequently 50 or 60 feet, and it is only on a few of the steeper slopes along the larger streams that shale or limestone outcrops at the surface.

Although occurring at varying altitudes, the type in general is characterized by great uniformity in texture, color, and structure. There are, however, several minor variations from the typical soil. In the eastern and southeastern parts of the county, particularly around East Lynne and Creighton, and along the southern border of the county near Archie, there are poorly drained areas where the soil is notably lighter in color, owing to a lack or a peculiar condition of organic matter. These areas are considered of inferior agricultural value as compared with the darker land, but the difference in crop value and in physical properties is too slight to justify a separation of this phase. It is locally known as "ashy land," but compared with the ashy land in Bates and other counties to the south it does not deserve such a term.

Near some of the streams where erosion has been active the color of the soil is considerably lighter than that of the typical soil, being a grayish brown or brown, and the underlying rock comes nearer the surface. There is an extensive area of this phase east of Everett along the Grand River and around Austin. Here the soil is a brown silt loam, underlain at about 10 inches by light-brown silt loam, and at 14 inches by a mottled brownish and gray silty clay loam, which at about 20 to 24 inches passes into a tough, plastic, heavy clay of a dark-brown or dark yellowish brown color in the upper part and mottled with grayish and yellowish brown in the lower section. Shale fragments are frequently encountered in the soil and subsoil. The agricultural value of this gently rolling phase is only slightly inferior to that of the typical soil.

On some of the slopes where erosion has removed the surface soil and exposed the subsoil, the surface material frequently consists of a black or dark-gray silty clay or clay loam, underlain at about 10 inches by a dark, heavy, plastic clay. These areas were not mapped separately on account of their small size and irregular distribution. They have their most extensive development northeast of Harrisonville, and mark the eastern slope of the central escarpment where this escarpment consists of Summit silt loam. Limestone fragments are usually scattered through the soil of this phase. It is best adapted to grass and small grains. The soil is not very drought resistant and needs large applications of manure to insure good yields.

The soil material of the Summit silt loam is derived mainly from shale and to a small extent from thinly bedded limestone. In places material from sandstone enters into the composition of the type. Locally this type is known as "black land" or "black limestone land," implying that it is derived from limestone, although only a small part of the material is from this source. The presence of limestone material is important in that it assists in giving the soil mellower texture and in making it more productive. The character of the material would indicate that limestone enters more largely into the formation of the soil as developed on the intermediate platform than it does in the lower southeastern division of the county. It is probable that for this reason the soil in the former section is considered somewhat better than that of the latter, but there are no data to substantiate this belief.

Almost all of the type was originally prairie, and when first broken the soil contained a large amount of organic matter. At present a few of the hilly areas along the streams support a growth of young oak, hickory, and persimmon.

The Summit silt loam is not only the most important soil type in Cass County, but in all west-central Missouri. It is prized on account of its high productivity and desirable physical and topographic

features. Nearly all of the type is in a high state of cultivation and is used for the production of corn, wheat, grass, and oats, which crops rank in importance in the order named. Yields range as follows: Corn, 30 to 75 bushels; wheat, 15 to 35 bushels; oats 20 to 50 bushels; and grass, 1 to 2½ tons per acre, the higher figures being approached more frequently than the lower. As a grass and small-grain soil the Summit silt loam is especially desirable. Tobacco is grown on a commercial scale and with good results. Yields range from 1,000 to 1,600 pounds per acre. Alfalfa is not grown on the type, and on account of the heavy subsoil will not thrive unless good drainage and an abundance of plant food are provided.

Commercial fertilizers are not used, but applications of phosphatic materials would probably prove profitable. Applications of ground limestone would be beneficial in the poorer drained areas. In the management of this type, the most important factor is the maintenance of the organic matter supply. Whenever this constituent is lacking the nitrogen supply is deficient and the soil more apt to puddle, which condition is unfavorable to the best physical and chemical conditions and biologic processes. This will be especially true if cropping has reduced the amount of organic matter below that necessary to maintain good tilth. Every practical means should be used to maintain the supply of organic matter. Clover or cowpeas should be grown on the land every 3 or 4 years, and the bulk of the crop turned under, either directly or after removing the seed or after feeding and bringing back all the manure. All of the straw should be returned to the land and plowed under, if not used as bedding or feed, and stalks should be chopped up and turned under, as well as weeds and trash. In this way only can the present fair supply of organic matter and its accompanying nitrogen be maintained in the soil. Such deep-rooting crops as red and mammoth clover will also tend to make the compact subsoil more porous.

The value of tile drainage has not yet been ascertained, but it is probable that it would prove profitable, especially on flat uplands and at the head of shallow draws. Where this soil is not well drained alsike will grow better than red clover. Pasturing is one of the best uses of this land. Alsike and white clover should be included in the mixture of grass seed.

Land of this type sells for \$65 to \$135 an acre, depending on location and improvements, with most sales being made at \$90 to \$100 an acre.

Summit silt loam, friable subsoil phase.—The friable subsoil phase of the Summit silt loam was mapped in large areas in the northwestern part of the county. It consists of a mellow, dark-brown to black silt loam, underlain at about 15 inches by dark-brown or yellowish-brown, moderately friable or crumbly heavy silt loam to silty clay.

which grades at about 20 to 24 inches into yellowish-brown, crumbly clay or silty clay, which is generally heavier and mottled yellowish red, yellow, brown, and gray in the lower portion. In the smoother areas of this phase the subsoil is slightly darker and heavier than in the rolling areas. In general, the subsoil of the phase averages considerably lighter in color, being a more yellowish brown, and less plastic than the typical Summit silt loam. The friable subsoil phase has a mellower soil than the main type with a very faint brownish color in many areas and for the most part it occupies a higher topographic and geologic position. The greater part of the northwest platform is occupied by this phase. Its topography is smooth to gently rolling, and practically the entire extent of it is in a high state of cultivation.

The soil material of this phase is derived chiefly from limestone and shale, the former probably entering into the formation more largely than the latter. Limestone outcrops are more numerous than in the typical soil. The presence of the larger amount of limestone material gives the soil a loamy structure and a reddish or brownish color.

The friable subsoil phase, or "mulatto soil," as it is called locally, is recognized as the best soil in the county. It is more easily kept in good condition of tilth, crops are less likely to suffer from the effects of drought, and it seems to be somewhat more productive than the typical soil. In the spring and after heavy rains the phase can be cultivated from 1 to 3 days earlier than the typical Summit silt loam. These advantages, however, are frequently counteracted by the greater washing to which the soil is subject.

Practically all of the phase was originally prairie. It is used for the production of all the staple crops common to the region and large yields are obtained. Clover and alfalfa do especially well. For fruit and certain vegetables it is unexcelled by any other soil in the county. The adoption of a rotation to include clover or alfalfa every three years is of primary importance in the management of this soil. Some crops such as cowpeas, Canada field peas, alfalfa, or clover should be turned under occasionally in order to maintain the supply of organic matter. Listing is practiced with success, but is not recommended, especially on those areas subject to erosion. Very little, if any, of this land can be bought for less than \$100 an acre.

Narrow bodies of Crawford silt loam, confined to the lower slopes near drainage ways and too small to map separately, were included with this phase.

SUMMIT STONY CLAY LOAM.

The Summit stony clay loam occupies the steep, stony slopes near streams, the sides of ridges, and isolated hillocks. In these areas thin-bedded limestone outcrops and fragments of the stone are scat-

tered over the surface. The soil material is generally a yellowish, yellowish-brown, or grayish silt loam or silty clay loam to clay grading at about 6 or 8 inches into a yellowish-brown or gray, plastic, sticky, heavy clay. At lower depths a light-yellow, plastic clay is encountered. The material is rarely over a few feet in depth, and is underlain by partially decomposed bedrock. The soil is residual from shale and limestone.

The steep slopes and the stone fragments practically preclude cultivation of these areas. The soil material, on account of its heavy texture, is not drought resistant. The type is used almost exclusively for pasture, although a few acres are covered with a scrubby growth of oak, hickory, and elm. It is probable that the better areas could be used for orchards. Both grass and clover do fairly well, and in general the best use of this stony land is for pasture.

CRAWFORD SILT LOAM.

The Crawford silt loam is locally known as "red land" on account of the characteristic red color of the soil or subsoil. Typically the soil consists of a dark-brown to reddish-brown or brown mellow silt loam which grades at about 12 to 15 inches into a lighter colored, crumbly silty clay loam. This is underlain at about 18 to 20 inches by chocolate-red or reddish-brown to red, rather stiff, brittle clay. In places the soil ranges to nearly black. The color of the soil material depends largely on the activity of erosion and proximity to limestone outcrops. Where erosion has removed the soil, leaving the subsoil exposed, and where the material is recently weathered from limestone, it has a bright-red or brown color, but when mixed with organic matter it has a much darker color.

The topography of the type varies from smooth to gently rolling or undulating, the smoother areas being most extensive in the northwestern part of the county. In general, the type has a more uneven surface than the Summit silt loam. It occupies slopes along drainage ways and higher undulating areas. It is usually drained by numerous small streams which have cut down to the limestone beds, or through them, and are now bordered in places by perpendicular ledges varying in height from 10 to 35 feet. Although practically all of the type is easily cultivated, the rock ledges render tillage difficult in places, and frequently limit the size of the fields.

The soil material is derived almost wholly from limestone, and has its widest distribution where the rock strata were thickest. As a rule, the type is associated with rock outcrops, and in places bedrock is reached at depths varying from about 10 inches to 4 feet. Erosion is destructive in places. Most of the type was originally forested with oak, elm, walnut, ash, and locust, but practically all of it is now cleared.

The Crawford silt loam is a well-drained, good agricultural soil, well suited to the general farm crops of the region. Most farmers state that this "red land" is better than the black Summit soil, but others believe there is no difference in the agricultural value of the two types. The red soil, however, is known to be more drought resistant, more easily cultivated, and from two to eight days earlier in spring. It is an excellent corn and wheat soil, and is used almost exclusively for the production of these crops. As a tobacco, alfalfa, truck, and fruit soil it is the best in the county. Corn will average 35 to 60 bushels and wheat 15 to 25 bushels per acre. Both clover and alfalfa should be grown more extensively on the type.

Next to the friable subsoil phase of the Summit silt loam the Crawford silt loam is the most highly prized by the farmers. The two soils have nearly the same value.

CRAWFORD STONY CLAY LOAM.

The soil of the Crawford stony clay loam is a dark-brown to reddish-brown clay loam or silty clay loam, underlain at variable depths, usually about 6 to 10 inches, by rather stiff, brittle, red or reddish-brown clay, which extends to depths ranging from 10 or 15 inches to 3 feet. The bedrock generally consists of limestone. Fragments and outcrops of limestone are abundant. The soil is residual, being derived from the weathering in place of beds of limestone, and in this respect differs from the Summit stony clay loam, which is derived from both shale and limestone. Some included patches of Summit stony clay loam were not mapped separately on account of their small size.

The Crawford stony clay loam occupies steep slopes along drainage ways, frequently representing bluff lines, and some of the higher outlying elevations. The abundance of rock fragments and rock outcrops and the steep slopes render the greater part of the type unfit for cultivation. It has its greatest development in the west-central part of the county, and most of it is forested. When cultivated the type produces good crops of grass and small grain. Its best use is for pastures, orchards, and forests.

OSWEGO SILT LOAM.

Several small areas of Oswego silt loam were mapped in the southern part of the county. They represent the northern edge of the type, which has its extensive development to the south, in Bates County.

The soil consists of a black or dark-gray silt loam, underlain at 10 to 12 inches by a light-gray or drab, crumbly silty clay loam, which at 18 inches passes abruptly into a tough, plastic, waxy, heavy clay of

a very dark brown, black, or dark yellowish brown color. In the lower portion the color is more nearly yellow, and usually is mottled gray and yellow. On drying the soil at the surface becomes grayish, but it never assumes the decided light color of the "white ashy land," or Cherokee silt loam, which occurs to the south. The soil material is derived from shale. The type occupies low, flat areas having rather poor surface drainage. Iron concretions are abundant in the sub-surface soil and subsoil of some areas.

All of the type is in cultivation. It is devoted mainly to the production of wheat, oats, and grass, for which it is best suited. The yields are somewhat lower than on the Summit silt loam. In the management of the soil, good surface and underground drainage should be provided. With a liberal use of ground limestone, phosphatic fertilizers and legumes, the productivity can be materially improved. Clover and cowpeas should be grown every three or four years and the green crop turned under in order to supply much needed organic matter.

BATES SILT LOAM.

The Bates silt loam is one of the most variable types in the survey. In its typical development the soil consists of a grayish-brown, fairly mellow silt loam, underlain at about 10 inches by a yellowish-brown, friable silt loam or silty clay loam, which at 16 to 18 inches overlies yellow silty clay, mottled faintly with gray or shades of yellow and brown. This becomes heavier and more plastic with increase in depth.

The type occupies ridges and ridge slopes, and relatively low, flat to undulating areas. On the ridges and slopes shale fragments are common in the soil and bed shale is occasionally reached within the 3-foot section. The relatively low, flat to undulating areas, usually adjoining streams, have a heavy, plastic subsoil which is similar to the lower subsoil of the Summit silt loam.

The soil material is derived almost wholly from shale. In places thin limestone beds and some chert were noticed in association with the type, but limestone has influenced the soil only to a negligible degree. This development of the Bates silt loam is not altogether representative of the typical soil as elsewhere mapped, because of the absence of the red color in the subsoil. In other respects the soil possesses the Bates characteristics, so that its correlation as Bates silt loam is considered advisable.

The surface drainage of the type is good, yet in places the soil is wet and soggy, owing to the accumulation of seepage waters from higher areas, the downward course of the water being obstructed by the impervious shale strata in the lower subsoil. Such areas could be improved by tile drainage.

The rougher land of the type was originally forested, but the smoother portions were prairie. A part of the bench-land phase, including the low areas, is characterized by its growth of post oak. The Bates silt loam is probably the poorest soil in the county. It is used most extensively for pasture land, for which use it is best suited. When cultivated, fair yields of corn and wheat are secured. The soil is low in humus, which should be supplied by methods previously described, in order to get the best results.

BATES LOAM.

The Bates loam was mapped only in the southern half of the county, the greatest development consisting of small, scattered areas in the southeastern corner. The typical soil consists of about 12 to 15 inches of mellow, fine loam, brown or dark brown in color. The subsoil is a yellowish-brown to reddish-brown, friable, heavy loam to fine sandy clay loam. The lower portion varies to nearly red or red mottled with yellow. Bedrock is usually encountered at about 3 feet, although in places on the steeper slopes it is nearer the surface.

The soil material is derived mainly from thin beds of fine-grained sandstone, together with shale. Small sandstone fragments are scattered throughout the soil.

The type occupies slopes to streams and narrow ridges. Drainage is frequently excessive.

The soil is best suited to corn, vegetables, and clover. Lime and large quantities of organic matter should be applied to the land. Crop yields could probably be increased by the use of phosphatic fertilizers or even complete fertilizer mixtures.

OSAGE SILT LOAM.

The Osage silt loam is a black to dark-gray, mellow silt loam, which at about 18 to 20 inches grades into very dark gray or drab to black, plastic silty clay. Rusty-brown mottlings are common through the soil section, while the deeper material is sometimes mottled with yellowish and gray. Adjoining the stream banks the material is usually lighter in texture, occasionally approaching a loam or fine sandy loam, but these areas were too small and irregular to be shown separately on the map. Along the smaller streams the texture is more variable than in the broader bottoms of the larger streams, ranging from silt loam to loam within small areas. The forested areas of the type are usually lighter in color than the typical soil. In general, the type is darker in color in the northern half of the county than in the southern half.

The Osage silt loam occurs along nearly all the streams and occupies the valley bottoms completely, except where interrupted by the Osage clay. The material consists of recent alluvium, deposited in times of overflow. It is derived wholly from the residual prairie

soils of the uplands. Along the outer edge of the larger stream bottoms, and along all the smaller draws, the material is frequently influenced by colluvial wash from the adjoining slopes. A few small patches of grayish silt loam are mapped with the type. These are of little importance because of their small total area. They really include soils which have a lighter color than the typical soil, due to some peculiarity of drainage.

Where the stream bottoms are included within areas of the Crawford soils, the edge of the valley is usually marked by abrupt banks, but where included within the Summit soils, the rise from the valley to the upland is usually a very gradual one.

The type is subject to overflow, and for this reason much of it remains forested, especially the wider bottoms. Where the type is not overflowed deeply the drainage conditions are good, although tiling would be beneficial in most places.

The soil is easily handled and is highly productive. It is adapted to all the staple crops of the region, especially corn and clover. Corn produces from 40 to 80 bushels per acre. Where moisture conditions are good, and the land is not subject to overflow, it is an excellent alfalfa soil. The soil is in need of good drainage and organic matter. Lime should be added to correct any acidity in the soil and subsoil. It is doubtful if the use of commercial fertilizers would prove profitable.

OSAGE CLAY.

The Osage clay is a black, heavy, plastic clay, grading at about 9 or 10 inches into a black, dark-gray or bluish-black to drab, heavy, waxy, tenacious clay. The material, especially at lower depths, is usually stained with brownish iron compounds. The soil cracks on drying and is very sticky and plastic when wet.

This is a bottom-land soil found in the first bottoms of streams. It is generally developed in the broader bottoms and is subject to overflows which are often prolonged. The largest areas of the type are found along Grand River and Big Creek. It has been formed by deposition from stream-overflow water and back-water. Each inundation deposits a thin layer of fine clay material washed from the upland soils.

The greater part of the clay bottom is covered with wild grass, which yields from 1 to 4 tons of coarse hay. The soil in forested areas has a lighter texture and a lighter color. Very little of the type is cultivated on account of poor drainage and the difficulty with which the soil is handled. It is a good corn and grass soil, and when moisture conditions are favorable yields of 50 to 75 bushels of corn and 1 to 2½ tons of hay are obtained. Small grains would probably make too rank a growth, and alfalfa will not thrive well. Tile drainage would probably be of great benefit to all of this soil. Heavy applications of lime should be made, and fall plowing and the plowing under

of large quantities of coarse vegetable matter should be practiced in order to improve the structure and the moisture condition of the soil.

SUMMARY.

Cass County is situated in the Great Plains region of western Missouri. The county contains 712 square miles, or 455,680 acres, more than 90 per cent of which is highly improved farming land. It has a smooth to gently rolling topography. The transportation facilities and all other physical improvements of the county are good. A population of 22,973 is reported in the 1910 census. The great majority of the inhabitants are engaged in agricultural pursuits.

The average annual temperature is 53.1° F., and the average annual precipitation 37.88 inches.

The agriculture of the county is based on general farming combined with stock raising and stock feeding. Corn is the most important crop. The acreage devoted to wheat, clover, and tobacco should be extended. The soils, markets, and shipping facilities are favorable to a greater development of the dairy industry. Improvements in farm practices should be along the line of better crop rotations, the more extensive use of legumes, especially clover, and the incorporation of more organic matter in the soil.

The average value of land per acre is given in the 1910 census as about \$60. Prices range from \$40 or \$60 to about \$135, most sales being made at about \$100 an acre.

The upland soils of the county are separated into three groups, based on origin. The Summit soils are derived from limestone and shale. These are the most extensive soils in the county and are characterized by their black color and heavy clay subsoils. They are very productive and suited to all staple crops, of which corn, grass, wheat, and oats are the most important.

The Crawford soils, derived from limestone, are marked by their red color and mellow structure. They are fertile, and adapted to the staple crops of the region and to tobacco, truck, and fruit.

The Bates soils, derived from shale and sandstone, are low in humus and are best suited to grass.

The alluvial soils occur along all the streams and are generally subject to overflow and in need of artificial drainage. They comprise some of the most productive land in the county. The heavier soil is used for grass production. The lighter soils are suited to corn, grass, alfalfa, and garden truck.

In general, the soil, physical features, and climate of Cass County are not excelled in any part of Missouri and the agricultural practices are of the kind most approved. A general condition of prosperity prevails throughout the county.

[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 the 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.]

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