# SOIL SURVEY OF GAGE COUNTY, NEBRASKA.

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## DESCRIPTION OF THE AREA.

Gage County is located in the southeastern part of Nebraska, bordering the State of Kansas. It is bounded on the north by Lancaster County, on the east by Johnson and Pawnee Counties, on the south by the State of Kansas, and on the west by Jefferson and Saline Counties. The northern boundary of the county is about 18 miles south of Lincoln, the State capital. The county is rectangular in shape. It is 36 miles long from north to south and 24 miles wide from east to west, and contains 25 townships. It comprises an area of 856 square miles, or 547,840 acres.

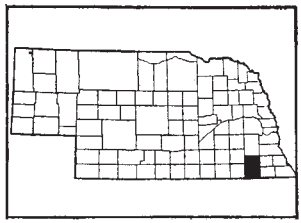

FIG. 60.—Sketch map showing location of the Gage County area, Nebraska.

Gage County lies entirely within the glaciated part of the physiographic province known as the Great Plains. The general surface configuration is that of a plain sloping toward the southeast, with the original constructional upland surface modified by stream erosion, giving rise to eroded slopes, terraces, and alluvial flood plains.

The upland consists of the loess-plain and slope land. The loess plain represents the original constructional surface and constitutes the highest part of the county. The topography is almost flat to slightly undulating, the only relief being afforded by a few stream valleys and shallow, basinlike depressions. The valleys are shallow, but, as a rule, somewhat sharply cut, except along the edge of the loess-plain areas, where the streams are rather numerous and the slopes long and gentle. In the plains the arrangement of streams is more irregular than on the slope land, where the development of streams and valleys has progressed evenly. The remnants of the loess plain are small, and, owing to the headward erosion of numerous streams, the edges are very irregular. The most extensive areas occur in the vicinity of Cortland and Ellis, but there are several smaller bodies in other parts of the county. In the southeastern section only a few remnants have escaped destruction by erosion. These remnants consist of flat-topped divides which vary from several rods

to a few miles in width. They cover a total area of about 100 square miles.

The slope land denotes the topography reduced by erosion. It includes a large number of ridges and valleys. Generally the slopes are moderate and the dissection extends to a depth of 100 to 200 feet. In the northeastern part of the county in the Big Nemaha River basin dissection is deeper and the slopes comparatively steep. South and southwest of the loess plain at Virginia the slopes are rather steep, and in the southeastern part of the county the long, gentle slopes on the north side of the stream valleys and the steep to abrupt slopes on the south side are a marked feature of the land surface. South of Blue Springs, along the Big Blue River and its tributaries, and to a less extent in other places, the bedrock lies at a relatively high level and produces steep to almost precipitous slopes along the edges of valleys, while back from the steep valley edges the relief is very moderate. The transition from the loess plain to the drift hills is usually marked by a long, gentle slope and in a few cases by a lower level with a slight dip to the streams. North of Ellis the slope between the loess plain and the drift hills is rather steep. As a whole the destructional surface is characterized by a gently rolling to rolling topography, with steeper slopes along the major drainage ways, especially where the bedrock is exposed along the valley sides. There are a number of lower lying flats in the rolling upland which have a topography similar to the loess plain.

The terraces occur chiefly along the Big Blue River and consist of two distinct series, the high and the low terraces. The high terraces are about 40 to 55 feet above the present flood plain and the low terraces 10 to 25 feet. There are two levels of the lower terraces, one 10 to 15 feet above the flood plain and the other about 25 feet above. In general the surface of the high terraces is flat, though slightly dissected by the tributaries of the larger streams. The area occurring in sections 27, 28, 29, 32, and 33, Rockford Township, has been considerably modified by erosion and has an undulating topography. It approaches the upland from the standpoint of soil classification. The lower terraces are less eroded than the higher and are usually distinctly benchlike, except where they occur as very narrow bands, as in the case of the area 3 miles southeast of Wymore and the one 2 miles southwest of Clatonia. High terraces are extensively developed in Gage County, occurring chiefly north of Blue Springs along the Big Blue River and extending through Saline County into Seward County. The low terraces are rather restricted and occur as narrow, disconnected strips mainly along the Big Blue River, northwest of Beatrice. The transition from the upland to the high terraces is usually marked by a long, gentle slope and the boundary line is rather arbitrary; the slope is generally moderate though distinct,

and the same is true of the slope between the high and low terraces where they are associated.

The area of bottom land, in comparison with the area of upland and terraces, is rather small, largely on account of the hard, resistant bedrock in the southern part of the county. The main area of bottom land, varying from a few rods to about 1½ miles in width, occurs along the Big Blue River. Other large areas are encountered along Big Indian Creek and Big Nemaha River. There are a number of smaller areas along the other streams of the county. The surface of the bottom land is generally flat. Along the Big Blue River the topography is relieved by such minor features as low benches, depressions, cut-offs, old channels, overflow channels, and intervening ridges. The slopes between the terraces and the bottom land are usually very gentle, except where the stream impinges against them, and the slopes between the upland and bottom land are usually gentle, though steep to almost precipitous where capped by bedrock. Such slopes are largely confined to the southern part of the county.

Gage County is drained by two important streams, the Big Blue and Big Nemaha Rivers. The Big Blue River enters the county about 8 miles southwest of Clatonia and follows a southeasterly course, entering the State of Kansas at a point about 4 miles south of Barnston. It drains practically all of the county except the northeastern corner, which is drained by Big Nemaha River. The general slope of the county is sufficient rapidly to dispose of the rainfall in all sections. The Big Blue River supplies power northeast of De Witt, and at Beatrice, Holmesville, and Blue Springs.

The first permanent settlement in Gage County was made in 1855 on Plum Creek, in the southeastern part of the county. The county was created by the Territorial Legislature in 1855 and organized in 1857, with Beatrice as the county seat. At that time the county was not so large as at present, but in 1864 eight townships on the north, before that a part of Clay County, were added. Most of the early settlers came from Missouri, Iowa, Illinois, and other eastern States, but immigrants subsequently came from Germany, Bohemia, Holland, and Wales. People of German descent live mainly in the northern part of the county, the Bohemians in the southwestern and extreme northwestern sections and in the vicinity of Virginia in the eastern part, the Dutch in the northeastern part, and the Welsh in the section south of Wymore.

The population of the county is reported in the 1910 census as 30,325, of which 60.5 per cent is reported as rural. The density of the rural population is 21.3 per square mile. Beatrice, the county seat, with a population of 9,356, is located 3 miles west of the geographical center of the county. It is an important distributing point

for agricultural implements and supplies. A number of important manufacturing plants, two creameries, and three grain elevators are situated in this city. Wymore, in the south-central part of the county, is the second largest town, with a population of 2,163. It is an important railroad point. Blue Springs, an incorporated town of 712 inhabitants, adjoins Wymore on the north. A number of smaller towns of local importance are scattered through the county.

Gage County has good railroad facilities, no point within the county being more than 9 miles from a railroad station. The main line of the Chicago, Burlington & Quincy Railroad crosses the southern part of the county from east to west, with a branch running northwest from Wymore to Beatrice and Crete. The Lincoln-Kansas City line of the same system crosses the northeastern corner of the county. Branches of the Burlington also run east from Beatrice to Nebraska City, Nebr., and southwest from Odell. The Union Pacific, from Lincoln to Manhattan, extends north and south through the middle of the county. The main line of the Chicago, Rock Island & Pacific Railway traverses the northwestern corner, while the Horton Branch crosses the middle of the county east and west. The Missouri Pacific Railway crosses the east county line to Virginia.

Practically all the highways are dirt roads. The main public roads are usually kept in good condition, though little attention is given to the less important roads. Practically all the streams and drainage ways are bridged.

The direct railroad connection with Lincoln and Kansas City gives the county access to good outside markets. In Lincoln there is a steady demand for most of the dairy products, and in Omaha, St. Joseph, and Kansas City for live stock and other farm products. Owing to the comparatively large urban population, there is also a good local demand for farm products. All parts of the county have rural mail delivery and telephone service.

## CLIMATE.

The climate of Gage County is marked by rather wide seasonal extremes. The winters are fairly long and cold and the summers quite warm. The spring is usually cold, with considerable precipitation; the fall season is usually long, with moderate temperatures and only occasional periods of rainy weather. The mean annual precipitation, as shown by the records of the Weather Bureau station at Beatrice, in the central part of the county, is 29.87 inches. The precipitation is heaviest during the months of June, July, and August, with a mean of 12.98 inches, and lightest during the months of December, January, and February, for which the mean is reported as 2.43 inches. The greater part of the precipitation in the summer occurs as local storms. The rainfall in May and June is

well distributed, periods of drought being practically unknown. In July the distribution is less favorable, and during August and September the rainfall is lighter, so that long periods of drought occasionally occur in these three months. Crop failures have been rare, although the yield of corn is sometimes reduced by drought and hot winds.

The mean annual temperature is 51.2° F. January and February are the coldest months, with mean temperatures of 25.3° F. and 25.2° F., respectively, and July the warmest, with a mean temperature of 76.1° F. This gives a range in mean temperature between the coldest and warmest months of about 51°. The lowest temperature recorded is —33° F. and the highest 108° F. The average date of the last killing frost in the spring is May 1 and of the first in the fall, October 5. The date of the latest killing frost recorded in the spring is May 27 and of the earliest in the fall, September 12. The average length of the growing season is 157 days. The seasons are normally long enough to insure the successful production of corn.

From April 1 to October 1 the prevailing wind is from the south and from October 1 to April 1 it is from the northwest. Strong winds are common, though tornadoes are of comparatively rare occurrence.

According to the records at Lincoln the relative humidity is comparatively uniform. The average annual humidity is about 70 per cent. The same records show an average of 175 clear days, 81 to 86 cloudy days, and 109 partly cloudy days.

The following table gives the normal monthly, seasonal, and annual temperature and precipitation for the county, as recorded at the Weather Bureau station at Beatrice:

*Normal monthly, seasonal, and annual temperature and precipitation at Beatrice.*

| Month. | Temperature. | | | Precipitation. | | |
|---|---|---|---|---|---|---|
| | Mean | Absolute maximum. | Absolute minimum. | Mean. | Total amount for the driest year. | Total amount for the wettest year. |
| | °F. | °F. | °F. | *Inches.* | *Inches.* | *Inches.* |
| December | 29.1 | 64 | —17 | 0.84 | 0.90 | 0.48 |
| January | 25.3 | 64 | —23 | 0.52 | 0.32 | 0.40 |
| February | 25.2 | 78 | —33 | 1.07 | 1.33 | 0.40 |
| Winter | 26.5 | | | 2.43 | 2.55 | 1.28 |
| March | 38.3 | 91 | —11 | 1.41 | 0.90 | 1.30 |
| April | 52.0 | 100 | 12 | 2.51 | 1.31 | 2.08 |
| May | 61.5 | 96 | 24 | 4.62 | 1.43 | 10.30 |
| Spring | 50.6 | | | 8.54 | 3.64 | 13.68 |

*Normal monthly, seasonal, and annual temperature and precipitation at Beatrice*—Continued.

| Month. | Temperature. | | | Precipitation. | | |
|---|---|---|---|---|---|---|
| | Mean. | Absolute maximum. | Absolute minimum. | Mean. | Total amount for the driest year. | Total amount for the wettest year. |
| | °F. | °F. | °F. | *Inches.* | *Inches.* | *Inches.* |
| June | 71.2 | 105 | 40 | 4.75 | 7.28 | 5.27 |
| July | 76.1 | 108 | 42 | 4.33 | 1.39 | 7.52 |
| August | 74.9 | 104 | 40 | 3.90 | 0.00 | 8.43 |
| Summer | 74.1 | | | 12.98 | 8.67 | 21.22 |
| September | 67.2 | 101 | 24 | 2.67 | 3.03 | 2.01 |
| October | 54.8 | 92 | 15 | 2.39 | 2.49 | 2.68 |
| November | 39.1 | 76 | − 5 | 0.86 | 0.00 | 1.26 |
| Fall | 53.7 | | | 5.92 | 5.52 | 5.95 |
| Year | 51.2 | 108 | −33 | 29.87 | 20.38 | 42.13 |

## AGRICULTURE.

Originally nearly all of Gage County, except forested strips along the drainage ways, supported a luxuriant growth of prairie grasses. With settlement, beginning in 1855, the pioneers began to break up the native sod for the production of crops, mainly corn and flax, which became the principal money crops. Hay also became important. Ranching was carried on to some extent, but never became an important industry. Some vegetables and potatoes for home use, in addition to small quantities of wheat, buckwheat, rye, oats, barley, and sorghum, were grown. Flax did particularly well on the virgin soil for two or three years, when the yields began to decline. It continued, however, to be one of the chief money crops until 1870, when spring wheat began to receive increasing attention, finally succeeding flax as a cash crop. The "tea" wheat was grown several years as a spring wheat and was later superseded by "grass" wheat, also a spring variety. About 1885, owing to decreased yields and low prices, wheat was practically abandoned as a cash crop and the growing of flax was revived, until in 1889, according to the census report, 23,375 acres were in flax and only 5,660 acres in wheat. Flax was grown merely as a temporary crop to take the place of wheat during the years when the latter was not profitable. About 1888 it was discovered that "grass" wheat could be grown as winter wheat, and since then winter wheat has received increasing attention, its production being further stimulated by the introduction of a variety known as the Turkey Red.

Barley, rye, buckwheat, potatoes, and sorghum have always been minor crops. About 1885 the growing of broom corn attained some importance. Owing to the difficulty of obtaining cheap labor, however, it did not prove profitable and was discontinued. With the exception of the "grasshopper year"—1874—and the three years of protracted droughts—1894, 1901, and 1913—the agricultural history has no failures to record. In 1913 the corn crop was practically a failure over the entire county, the average yield being not much over 5 bushels per acre.

The present agriculture of the county consists mainly of grain production, though increasing attention is being given to dairying and the raising of hogs and other live stock. Corn, wheat, oats, wild hay, prairie grasses, alfalfa, and timothy and clover are the chief crops, ranking in the order named. The type of farming is remarkably uniform over the entire county. More corn is grown on the bottom land than on the upland, while the opposite is true of the small grains.

In point of acreage corn is the predominant crop in Gage County, about 40 per cent of the total area of improved farm land being devoted to it. A production of 3,594,638 bushels from a total of 191,750 acres is reported by the 1910 census, indicating an average yield of about 18 bushels per acre. Corn is grown on all the improved types in the county, but does best on the bottom-land soils. The acreage devoted to corn has been steadily decreasing since 1900, while that in alfalfa and wheat has increased. The occurrence of hot winds and droughts during July and August in some years causes considerable damage to the corn crop and curtails the production appreciably. When the rainfall is sufficient throughout the growing season the crop does well, yielding from 35 to 45 bushels per acre. Reids Yellow Dent, Iowa Silver Mine, and Leaming Improved are the most popular varieties of corn grown in the county.

On tenant farms most of the corn is sold, while on farms operated by the owners a large percentage is fed to hogs and other live stock. It is a common practice to husk the corn from the standing stalks and store it in cribs, pasturing cattle and horses in the fields during the fall and winter. A few farmers cut some of the corn for winter roughage. According to records kept by the farm demonstrator of Gage County, there were about 70 silos in the county in 1914. Their number is gradually increasing. On the farms with silos from 10 to 15 acres of corn are cut for silage.

At present most farmers grow corn 2 years in succession in the same field, while some lengthen the period to 4 or 5 years. It does better where it is grown 2 years in a systematic rotation with small-grain and leguminous crops. Yields after the second year are appreciably lower.

Wheat is second in acreage to corn, and from field observations made during the progress of the soil survey there are apparently 2 acres of wheat to every 3 acres of corn. The present tendency is to produce about as much wheat as corn. The acreage has increased appreciably since 1900. The 1910 census reported a total of 78,203 acres in wheat, with a production of 1,607,699 bushels. At present the Turkey Red wheat is grown almost exclusively. This variety has taken the place of the spring wheats because it yields better, can be sowed in the fall at a time when the work does not interfere with the work of caring for other crops, and matures before the dry weather and hot winds occur. It is grown with profit on all the improved soils in the county, though not so generally on the bottom land as on the upland. The early maturing of the wheat crop enables it to avoid the droughts which sometimes occur late in summer. This fact, together with the stimulus of the present high prices, favors the further extension of the acreage of wheat. The Hessian fly does some damage to the crop.

As a rule wheat is grown two years in succession, following oats in the crop rotation. When grown more than two years in succession the yields decline. Where corn is cut for silage, wheat is generally grown after that crop, with excellent results. Wheat is strictly a cash crop, and, though many farmers retain a part of the grain, the bulk of it is usually sold direct from the thrashing machine.

The acreage of oats has noticeably decreased within the last decade. At present about 13 per cent of the total improved area in farms is devoted to the production of this crop. The 1910 census reports a total of 64,659 acres in oats, with a production of 1,630,934 bushels. This crop does well on all the improved upland soils; on the bottom-land types it is likely to lodge. The Kherson, a short, stiff-strawed variety, has given the best results on the bottom lands. Oats are a less profitable crop than either corn or wheat, although very desirable for horse feed. Most of the crop is fed to horses and other live stock. It occupies a step in the rotation which can not readily be filled by any other crop grown in the county; that is, following corn where matured for grain.

According to the census, there was a total area of 24,757 acres in tame hay and forage, with a production of 44,205 tons, in 1909, and 19,758 acres in wild hay, from which 24,807 tons were cut. The acreage in wild hay is comparatively large, considering that most of the bottom land is under cultivation. Wild hay is still cut on all the types of the county. Even on the Grundy and Carrington silt loams there are fields of prairie grass. It is probable that most of the virgin hay land suitable for cereal crops will soon be broken, as the use of land for wild hay is comparatively unprofitable. The

hay is usually stacked in the fields; a small part of it is baled and hauled to market, but most of it is used for feed on the farm. Some of the owners of large farms make a practice of leasing small hay lots to neighboring farmers. The rent varies with the stand of hay.

Alfalfa has become a permanent crop in Gage County, owing to its high feeding value and its renovating effect on the soils. The census reported a total of 8,859 acres in this legume in 1909, as compared with 555 acres in 1899. The production in 1909 was 23,936 tons. The crop does well on all the improved upland and bottom-land soils and is grown on a large number of farms. It is usually sowed after wheat and takes the place in the rotation formerly occupied by timothy and clover. The stand is ordinarily maintained for 5 to 7 years, though on a large number of farms alfalfa has been grown continuously for 10 years or more.

Timothy and clover are not grown very extensively, owing to the difficulty in getting a stand. As a rule, the rainfall between the middle of July and the middle of September is not great enough to enable the delicate clover plants to withstand the hot winds and occasional long droughts which occur after the nurse crop has been removed. If the rainfall is ample at the time it is most needed, immediately after the cutting of the grain crop, clover does well, yielding from 1½ to 2½ tons per acre. The 1910 census reports 8,384 acres in timothy and clover mixed, with a production of 10,176 tons; 4,531 acres in timothy alone, producing 5,500 tons; and 1,087 acres in clover alone, producing 1,421 tons. In the last few years the stands of clover have been poor. Some timothy is grown for seed, of which it yields ordinarily 4 to 8 bushels per acre. Of other hay and forage crops reported by the 1910 census there are 1,578 acres of millet, with a production of 2,764 tons; 934 acres of coarse forage, producing 2,168 tons; 318 acres of other tame or cultivated grasses, producing 408 tons; and 81 acres of grains cut green, producing 109 tons.

Some sorghum and kafir are grown. Sorghum does well, yielding from 3 to 4 tons of fodder and about 20 bushels of seed per acre. The seed is sold, and brings about $1 a bushel. The stalks are usually fed to stock. Scarcely any sorghum is grown for the production of sirup. Kafir yields ordinarily from 3 to 4 tons of fodder and from 20 to 40 bushels of seed per acre, with occasional yields of as much as 60 bushels. It makes an excellent feed for horses and cattle. Some farmers thrash the crop and feed the seed to chickens and hogs.

In the vicinity of Beatrice sweet corn is produced for the canning factory located at that place. This crop does best on the Wabash silt loam, though some is grown on the terrace and upland soils. The yields range from 2 to 5 tons per acre. The factory furnishes the seed and contracts for the crop in advance at $7 a ton for snapped

ears, delivered by the farmer. The stalks furnish early fall feed and also make good ensilage. The waste at the factory is stored in a silo and sold to the farmers at $4 to $5 a ton. In 1914, according to the report of the factory, about 700 tons of snapped ears of sweet corn were produced in the vicinity of Beatrice.

Nearly every farmer has a small garden of vegetables to supply the home demand. Market gardening is carried on around the towns, though not on a very extensive scale. Trucking is largely confined to the vicinity of Beatrice. Practically all of the farmers produce enough potatoes for home use, and in favorable seasons have a small surplus for sale. Often, however, they have to buy an additional supply, owing to the poor care given the potato patches. According to the census, 1,263 acres were devoted to potatoes in 1909, with a production of 96,268 bushels. A total area of 898 acres is reported in other vegetables.

There are a few small commercial fruit orchards in the county, most of them in the immediate vicinity of Beatrice. When given proper attention apples can be grown successfully, though they do not do so well as along the Missouri River bluffs. Most of the farmers have small orchards, containing different varieties of apples, peaches, cherries, pears, and plums. The farm orchards are given very little attention, and a large number of trees have died within the last few years. Small quantities of grapes, strawberries, blackberries, raspberries, and black walnuts are produced. The value of orchard products, small fruits, and nuts produced in 1909 is given in the census as $56,991.

Although dairying is still incidental to the production of grain, it is steadily becoming more important. In the vicinity of Beatrice there are several large dairies, each with 20 to 30 head of milch cows. Most of the milk is retailed at Beatrice. The average number of dairy cows kept on farms is about 6. Some farmers merely keep enough to supply the home, while others sell small quantities of milk, cream, or butter. Most of the farmers separate the cream at home. The surplus cream and, in a few cases, milk are usually hauled by the farmers to the local creameries, though some ship to Lincoln, Crete, or Omaha. There are three creameries in the county, one at Cortland and two at Beatrice, one of which has its main plant at Lincoln. Most of the cream is manufactured into butter and ice cream. The ordinary price of butter fat ranges in summer from 22 to 26 cents and in winter from 25 to 32 cents a pound. Most of the dairy cows are grade Shorthorn, though the Holstein is becoming popular. On the average farm little attention is given to the breeding, housing, and proper feeding of cattle. The value of dairy

products, excluding milk and cream used at home, is reported as $256,689 for 1909.

Little attention is given the raising of beef cattle. Many farmers fatten from 4 to 6 head of cattle for sale when prices are most favorable. A few farmers feed cattle obtained from the stockyards at Omaha or Kansas City, with good returns. Most of the beef cattle are Shorthorn, though there are some Red Poll and Hereford.

Practically all the farmers raise their own work stock and occasionally have a team to sell. More mules than horses are raised. The most popular breed of horse is the Percheron, but some Belgian, Shire, and French Coach horses are raised.

The raising of hogs is the most important live-stock industry. Ordinarily, from 20 to 30 hogs per farm, and sometimes as many as 200, are fattened each year for market, in addition to those slaughtered for home use. Most of the hogs, as well as other live stock, are kept on the farms operated by owners. On a few farms all the corn grown is fed to hogs, and as a rule this practice is profitable. Hog cholera has been a serious drawback to the development of the hog industry, but it is now rather well under control. Duroc Jersey, Poland China, Berkshire, Hampshire, and Chester White are the chief breeds.

The value of all animals sold or slaughtered in Gage County in 1909 is given in the census as $1,956,079.

On most farms poultry is a valuable asset. Forty to 150 chickens are kept on practically every farm, with geese, ducks, turkeys, and guineas in less numbers. The value of poultry and eggs produced in 1909 is reported by the census as $367,926.

The adaptation of certain crops to particular soils is recognized to quite an extent, and the better farmers follow soil adaptations in planting. It is recognized that the improved upland soils are best suited to corn, wheat, oats, and alfalfa, that the bottom lands are better adapted to corn than to small grains, and that the Shelby loam and Lancaster fine sandy loam are best used for grazing and the production of hay. Definite and systematic crop rotations are followed only by a few progressive farmers. The usual plan is to grow corn 2 to 4 years, oats 1 year, and wheat 2 years, when the field is returned to corn. Frequently corn is grown continuously on the same land for 10 years or more, especially on the bottom land, and wheat for 4 years, but oats rarely more than one year. When grown year after year, wheat and corn decrease noticeably in yield. Occasionally the wheat land is seeded to clover and timothy and allowed to stand in sod for 2 or 3 years, or to alfalfa for 5 to 7 years, and then returned to corn. Clover and timothy fit best in a short rotation, but their

production is decreasing, owing to the fact that alfalfa is a more certain crop. A rotation which is popular with some of the best farmers in the county is 2 years of corn, 1 year of oats, and 2 years of wheat, followed occasionally by a leguminous crop consisting either of clover with timothy or of alfalfa. On farms which have no permanent pasture, the clover and timothy is usually pastured the last year.

Stubble and sod are usually plowed in the fall if time permits. If corn follows wheat or a hay crop, the corn is either listed or checkrowed on the disked, plowed land, unless plowed in the spring, when the crop is listed. When corn follows corn the stalk land is disked 2 or 3 times before the seed is listed. Some farmers cut the stalks, if heavy, with a stalk cutter before disking. Corn is generally cultivated three or four times during the growing season. When checkrowed it is considered a good plan to harrow the field a number of times before the corn is large enough to cultivate to keep down the weeds. In preparing corn land for oats the stalks are either cut with a disk or a stalk cutter and the field is plowed in the spring and harrowed until in a mellow condition, the oats being seeded with a press drill. Some farmers disk the corn land a number of times, drag the fields, and then seed with a press drill. In a few cases the oats are sowed broadcast and either disked or otherwise cultivated in. Land for wheat, if the moisture condition is favorable, is plowed immediately after the grain crop has been removed. When too dry the land is harrowed as soon as possible and plowed after the first rain. It is left in this condition until time for seeding the wheat, when it is usually harrowed twice before the drilling of the crop. If a volunteer crop of grain has come up on the plowed field, it is disked before harrowing. As a rule plowing is shallow, only 4 to 6 inches deep, and in places a plowsole has formed. Where deeper plowing is practiced larger yields are obtained.

Green crops are seldom turned under and scarcely any commercial fertilizer is used. Ordinarily not enough barnyard manure is produced to supply the entire farm, and only the poorer spots receive liberal applications. Most of the manure is applied on the wheat stubble for corn, and some on the wheat land. Occasionally winter wheat receives a top dressing, which causes a material increase in yields.

Efficient farm labor is rather scarce, though usually enough help is obtainable to do the farm work. Laborers receive $25 to $30 a month, with board, if hired by the year. If hired from April 1 to December 1 they are paid $30 to $35 a month, with board. During wheat harvest day wages range from $1.50 to $3. A large number of farmers employ entire families in order to obtain more efficient

and reliable help, paying from $30 to $40 a month, with the privilege of keeping a cow, horse, chickens, and garden. Most of the farm work, however, is done by the farmers and their families. An expenditure of $290,772 for labor is reported for the county in 1909, about half the farms reporting outlay.

As a whole, the farm improvements are good and the buildings well kept. In general, the tenant houses are smaller and less substantial, though, as a rule, they are fairly comfortable. Most of the fences are of barbed wire, although the use of woven wire is increasing. There are numerous hedge fences along the farm lines, but the stunting of crops within a distance of 10 to 25 feet on each side of these hedges makes them undesirable. Labor-saving machinery is in general use.

There are 530,274 acres in farms in Gage County, according to the census of 1910, of which 485,671 acres are improved. The average size of farms is given as 170.9 acres, showing a slight increase over 1880, when it was reported as 168 acres. There are a number of large land holdings in the county, one holding comprising about 160 farms. The total number of farms is 3,103, of which 52.8 per cent are operated by tenants, 46.5 by owners, and 0.7 per cent by managers.

Both the cash and share systems, or sometimes a combination of the two, are followed in renting farms. Cash rents seem to be the most popular, and range from $3 to $5 an acre, depending on the nature of the soil. Alfalfa land rents for $5 to $10 an acre. A large number of farms are rented for $2.50 to $2.75 an acre with a provision that the tenant make all repairs and pay taxes. Under the share system the owner receives two-fifths—in some instances one-third—of the crops grown, all stock being furnished by the tenant. Where the land is rented on the basis of an equal division of the crops, the owner usually furnishes all implements and work stock. The latter method is not common. In the combination system the pasture and other land not used for growing crops is rented for cash and the grain and hay land on shares. In any system of renting the tenant is required to deliver the grain to the elevator.

The value of farm land in Gage County ranges from $40 to $150 an acre, depending on the character of the soil and the improvements and location. The average land value is reported in the census of 1910 as $79.93 an acre.

## SOILS.

The soils of Gage County are classed, on the basis of origin and mode of formation, into four principal groups: (1) Soils derived from loess, (2) soils derived from glacial drift, (3) residual or partly residual soils, and (4) alluvial soils.

The upland was originally covered with a layer of plains loess to a depth of 20 to 40 feet, but through erosion the deposit has been removed to a large extent. It now exists as high divides, having very irregular outlines. The best developed areas of loess plains are found in the vicinity of Cortland and Ellis, with a number of smaller areas scattered through the county. The loess weathers into the Grundy soil. The unweathered material varies in color from grayish yellow or light gray to yellowish brown and is more or less streaked with reddish iron stains. The material carries considerable lime, chiefly in the form of concretions.

Below the plains loess lies the weathered phase of the Kansan drift, which gives rise to the Carrington soil. It is rather difficult to differentiate between the loess and the weathered phase of the Kansan drift. The latter is heavier in texture and browner. Over the greater part of the formation bowlders are of rare occurrence. Areas in which they are common are classed with the Shelby series. Sand and gravel are not common. The boundary shown between the Grundy and the Carrington is in some cases largely arbitrary. The weathered Kansan drift occurs on slopes and has a destructional topography in contrast with the constructional topography of the Grundy. Where the areas of drift are almost flat to slightly undulating the soil is classed as the flat phase of the Carrington silt loam.

The weathered Kansan drift lies on the Kansan drift proper. There is a sharp line of demarcation in color and texture between the two. The upper part of the Kansan drift is thoroughly oxidized, showing that it has been subjected to weathering.

Undoubtedly the weathered phase has been so much altered by wind action that it has lost its drift characteristics and has assumed more of the properties of loess. The Kansan sheet proper is distinctly till, and consists of a heterogeneous mass of clay, silt, sand, gravel, and bowlders. The upper, oxidized zone varies in color from yellowish brown or brown to reddish brown. Below the oxidized stratum the drift changes to light gray or pale yellow, with numerous iron stains, while lime occurs in the form of concretions, seams, and marly pockets. On slopes subject to more severe erosion this material has given rise to the Shelby soil, which occurs along the slopes of drainage ways and is closely associated with the Carrington. In spots the drift has been removed by erosion, exposing the bedrock.

Below the Kansan sheet lies the Aftonian material, which consists largely of stratified sand and gravel, with a few bowlders. It is exposed along the Big Nemaha River, but its extent in other sections of the county is not known. This material has given rise to local sandy spots in the Shelby loam in the vicinity of Adams.

The lowest drift sheet, the Nebraskan, consists of a blue clay containing small pebbles, but fewer bowlders than the Kansan. It is exposed only in deep-cut banks.

The country rock consists of the Pennsylvanian, Permian, and Dakota formations. The Permian consists of shales and limestone, of which some, where not too flinty, are suitable for building purposes. The Florence flint of this formation extends into Kansas and forms the Flint Hills. The Permian beds are nearly horizontal, with a slight fold at Blue Springs. This formation is first exposed near Beatrice, with numerous outcrops throughout the southeastern half of the county. Approximately northeast of a line passing through Krider, Holmesville, and Adams the Dakota formation supports the mantle rock, overlying the Permian beds and possibly resting locally on the Permian and Pennsylvanian. The Dakota consists largely of a thick layer of rusty sand and clay not definitely classified. Where it is exposed it has weathered into a fine sandy loam which is classed with the Lancaster series.

The terrace soils in Gage County occur at two levels. The high terrace is of later age than the loess plains, while the lower is of still more recent origin. The terraces comprise fluvial silts which are very similar to the plains loess. The deposits vary in thickness from a few inches to about 20 feet. The bench formation, termed "valley loess" by the State geological survey, gives rise to the Waukesha soil. The basal material of the high terrace consists of a coarse sand and fine gravel, largely feldspar and quartz. Where exposed this material gives rise to the Sioux series.

Except along the Big Blue River, the bottom-land soils are very uniform in texture and consist mainly of silts. They are largely derived from the wash of the Grundy and Carrington silt loams, though locally influenced by other types. The bottom-land soils of the Big Blue River consist largely of silt and very fine sand. The silt is of practically the same origin as that along the other streams of the county, whereas the very fine sand is contributed to a large extent as wash from the sandy soils farther west along the Big Blue River and its branches. The black silt loam is classed with the Wabash and the brownish very fine sandy loam, with a slightly lighter colored and lighter textured subsoil, with the Sarpy series. Along the channels of the main streams of the county there is a narrow first bottom which sets off the remainder of the bottom land as a low terrace. Only along the Big Blue River was this low first bottom wide enough to be mapped, and owing to the impracticability of the separation of the soils it is classed as Meadow. The low first bottom is subject to frequent inundations, while the bottom land

proper is only occasionally overflowed, except along the Big Nemaha River, where there is no lower first bottom.

The following table gives the name and the actual and relative extent of each of the soils in Gage County:

*Areas of different soils.*

| Soil. | Acres. | Per cent. | Soil. | Acres. | Per cent |
|---|---|---|---|---|---|
| Carrington silt loam | 278,656 | 51.4 | Sioux sandy loam | 1,920 | 0.4 |
| Flat phase | 3,520 | | Meadow | 1,408 | .3 |
| Grundy silt loam | 100,992 | 18.4 | Cass silt loam | 704 | .1 |
| Wabash silt loam | 80,832 | 14.7 | Lancaster fine sandy loam | 512 | .1 |
| Shelby loam | 37,312 | 6.8 | Scott silt loam | 64 | .1 |
| Waukesha silt loam | 36,608 | 6.7 | | | |
| Sarpy very fine sandy loam | 5,312 | 1.0 | Total | 547,840 | |

GRUNDY SERIES.

The soils of the Grundy series are dark brown to black in color and overlie subsoils consisting of three successive layers. The upper layer, or subsurface material, is brown or light brown to grayish in color and a little heavier than the soil. The second layer, beginning at 16 to 24 inches, is a heavy, dark-brown to dark-drab and brown mottled clay, moderately crumbly when dry, but tough when wet. It usually extends to a depth of about 30 inches. The lower subsoil is a little lighter in color and a little less tough than the intermediate layer. The topography is usually flat. The material is derived from silty deposits of glacial age, usually defined as loess. Only the silt loam type is mapped in Gage County.

GRUNDY SILT LOAM.

The soil of the Grundy silt loam as it occurs in Gage County is typically a dark-brown to nearly black, heavy silt loam, 10 to 15 inches deep, with an average depth of 12 inches. The color is prevailingly dark brown. The upper part of the subsoil consists of a dark-brown to nearly black or dark-drab to dark-gray silty clay or clay. Frequently it is faintly mottled with lighter brown. This stratum is compact, hard, tough, and moderately crumbly when dry, and plastic and impervious when wet. The change from the soil to the subsoil is abrupt, though in the more rolling areas it is not so noticeable and the heavy stratum is not so prominent, being entirely absent in places. The upper part of the subsoil is spoken of as the "hardpan layer" by farmers, and where it is near the surface as "gumbo." At 24 to 30 inches the subsoil passes into a yellowish-gray or pale-yellow, and occasionally yellowish-brown, silty clay

loam, lighter in texture than the upper subsoil. It is friable and more open than the upper subsoil and often has a flaky or columnar structure. The lower subsoil is generally highly calcareous, the lime existing in the form of concretions, and it is more or less streaked and blotched with brownish iron stains. Below the 3-foot section the color usually changes to light gray. The soil is high in organic matter and friable, breaking down into a fine powder. It contains no sand or pebbles.

The Grundy silt loam includes small areas in which there is no hardpan and only a slight concentration of clay. The soil here is a dark-brown, heavy silt loam, 12 to 18 inches deep, underlain by a yellowish-brown silty clay loam. At 24 to 30 inches a yellowish-gray silty clay loam is encountered, apparently a little lighter in texture than the upper part of the subsoil. This development is similar to the Grundy silt loam in Seward County. It occurs mainly along draws and slopes on the edges of the type where it gives way to the Carrington silt loam. Along the shallow U-shaped valleys in the Grundy silt loam the light subsoil is frequently exposed.

The type is rather extensive, covering 157.8 square miles. Generally it forms small, irregular areas scattered throughout the county. There are two large areas, one surrounding Cortland, the other near Ellis.

The Grundy silt loam has a smooth or almost flat to slightly undulating, plainlike topography. It represents the original constructional surface of the county and occupies the highest topographic positions. Except along the edges of the type, there is scarcely any stream development. Where streams do cut back into the soil for any distance the valleys are shallow and U-shaped. As the loess is thin, most of the streams have cut through it into the drift, and where such is the case the valleys are deeper and have more tributaries, or a larger drainage basin, than those in Seward County. The loess plain in Gage County is considerably more dissected than the one in Seward County and has very few basinlike areas. The surface drainage is generally adequate, though in wet seasons, owing to the hardpan layer, it is not sufficient for the maximum production of crops. The type does not withstand drought so well as the Carrington silt loam. During periods of high temperature and hot winds the hardpan layer does not permit the upward capillary movement of water freely enough to supply the needs of crops, especially corn, and as a result the crops suffer considerably from lack of moisture. Occasionally the corn crop is ruined by hot winds, as it was in the season of 1913.

This type was originally covered with a thick growth of prairie grasses, only a few small patches of which remain.

About 93 per cent of the type is utilized for the production of cultivated crops. Corn is the principal crop, and does well in normal years, though in dry, hot seasons the yields are low. Ordinarily corn yields from 30 to 36 bushels an acre, and in favorable years, with proper cultivation, as much as 60 bushels. Wheat ranks second, and its acreage is gradually being extended. Ordinarily yields range from 18 to 25 bushels an acre. Occasionally 30 to 35 bushels are obtained. Oats are grown extensively, and the crop does well if it matures before the hot winds and dry weather occur. The average yield is 25 to 30 bushels per acre, and in favorable seasons as much as 30 to 60 bushels is obtained. Some barley is produced in the northwestern part of the county. Usually this crop does fairly well, yielding from 25 to 35 bushels an acre. Alfalfa is the principal hay crop, though considerable timothy and clover and some wild hay are produced. Usually three and sometimes four cuttings of alfalfa are obtained, with a total production of $2\frac{1}{2}$ to 5 tons per acre. In seasons of favorably distributed rainfall clover and timothy do well, yielding from $1\frac{1}{2}$ to 2 tons per acre. Wild hay runs 1 to $1\frac{1}{2}$ tons per acre. Millet does admirably on this type and ordinarily yields from 2 to 3 tons an acre. It is an unimportant crop and is usually grown in small patches. A few acres are devoted to kafir and sorghum, which do well.

Owing to its smooth topography and friable, silty, stone-free character, the greater part of this soil is very easily handled and can be worked under a wide range of moisture conditions. It is easier to handle than the Carrington silt loam, owing to the lighter texture of the surface soil. In places where the hardpan layer is near the surface, however, or is exposed, it is rather difficult to cultivate.

As the number of live stock kept on this type is small, there is but little barnyard manure available, and most of that is applied to corn land. It has a markedly beneficial effect on the physical condition of the "gumbo" spots. Scarcely any commercial fertilizer is used. Under the present system of farming the productiveness of the soil is gradually decreasing, especially on tenant farms.

The Grundy silt loam is considered the best upland soil in the county. Farm land ranges in value from $90 to $150 an acre, depending upon location, improvements, and general condition. It is generally valued at $10 to $20 an acre more than the surrounding areas of Carrington silt loam.

### Carrington Series.

The soils of the Carrington series are dark brown and occasionally black in color, and overlie brown to faintly reddish brown, silty subsoils, which are moderately friable and practically free from any concentration of clay in the upper part. The Carrington soils are

derived from glacial deposits, and carry a moderate to low content of lime. They have a smooth to rolling topography. In Gage County the silt loam type, with a flat phase, is the only member of the series mapped.

CARRINGTON SILT LOAM.

The Carrington silt loam is predominantly a dark-brown, heavy silt loam, with an average depth of 12 inches. The depth ranges from 6 to 15 inches, being greatest in the flatter areas. The soil is friable and rich in organic matter. It is underlain by a brown or yellowish-brown, compact silty clay, faintly mottled with lighter brown, though where thoroughly oxidized the mottling is entirely absent. At 24 to 30 inches the subsoil changes to a lighter textured silty clay or silty clay loam, in color pale yellow, grayish yellow, or in some places yellow mottled with light gray. The gray becomes more prominent with depth and below the 3-foot section the substratum is usually light gray in color and stained more or less with brown iron oxides. Where the subsoil is better oxidized the gray color is absent and the grayish brown or brown continues to a depth of about 40 inches. The change from soil to subsoil is rather gradual, though distinct. The upper part of the subsoil is hard, breaks down into granules when dry, and is only slightly plastic when wet. The lower portion is moderately friable. Occasionally lime concretions are abundant in the lower part of the soil section, though in general not so common as in the Grundy silt loam. Some pebbles and occasional bowlders occur on the surface.

On the lower slopes of this type, chiefly in the southern part of the county, in the vicinity of the Permian and Dakota beds, a soil with a reddish subsoil is encountered. This color, however, is an original-material color rather than one of oxidation, so far as the soil is concerned, and is therefore regarded as of incidental value only. The soil of this variation, to a depth of 10 to 15 inches, is a dark-brown, heavy silt loam, underlain by a chocolate-brown, heavy silty clay, which at 20 to 40 inches passes into rather bright reddish brown material.

Along drainage ways, where erosion has been rather rapid, the soil is a yellowish-brown, heavy silty clay loam or silty clay, 4 to 6 inches deep, passing into a brownish-yellow silty clay. At 15 to 24 inches the subsoil becomes very compact, plastic, and tough, these characteristics increasing in prominence with depth. The entire soil section has a reddish shade and is highly calcareous, with numerous black iron oxide pebbles. This variation is practically devoid of organic matter, and crops on it are stunted in growth. It is so small in extent that it can not be indicated satisfactorily on the soil map. It is locally termed "gumbo" land.

Along drainage ways in the southern part of the county the bedrock is generally near the surface, in many places being exposed. This condition produces a rough stony variation of the Carrington silt loam, which is indicated on the map by the rock outcrop symbol.

Along intermittent streams this type includes small, narrow slopes of colluvial material, which are too small to be shown separately on the soil map. This material is usually a black silt loam, with no change in texture or color within the 3-foot section. This colluvial soil merges gradually with the typical soil.

The Carrington silt loam differs from the Grundy silt loam in having a heavier and lighter colored surface soil, less abrupt change from soil to subsoil, and an upper subsoil not so dark colored, nor so heavy, hard, tough or plastic. Though the upper subsoil is heavier than the lower, the same change in both color and texture takes place as in the Grundy silt loam subsoil. In the lower subsoil they are more nearly alike, though the Carrington silt loam is browner and contains less lime. The Carrington silt loam occupies slope land, or a destructional topography, whereas the Grundy silt loam occupies a high, almost flat, constructional surface. The Carrington silt loam contains a few pebbles and bowlders, while the Grundy silt loam has practically none. Nearly all the transitional material between the Grundy silt loam and the Carrington silt loam is included with the Carrington, and the Grundy silt loam is rather strictly confined to the high flat land, with no pebbles or bowlders. Owing to the gradual change from one soil to the other, the boundary line drawn is largely arbitrary.

The Carrington silt loam is the most extensive type in the county, covering 51.4 per cent of the area surveyed. It occurs throughout the county, but is most extensively developed in the eastern and southeastern parts.

The type is thoroughly dissected, though the relief is not nearly so great nor the topographic forms so complex as in the eastern part of Seward County. As a whole, the surface is rolling and well drained. In the southeastern part of the county, east of the Big Blue River and south of Wildcat Creek, the type chiefly occupies long, gentle slopes to small streams. In T. 2 N., R. 7 E., and in a strip east of the Big Blue River, south of Wymore, this type has a gently rolling topography, and the valleys are shallow. This moderate relief on the Carrington silt loam in the southeastern part of the county is largely due to the position of the underlying rock strata. Where the Shelby loam is extensively developed the Carrington silt loam usually occupies gently arched divides.

The Carrington silt loam is derived from the weathered phase of the Kansan drift. Except on the steeper slopes, the type is not sub-

ject to destructive erosion. The soil is very retentive of moisture, and it is only during long droughts that crops suffer seriously from lack of moisture. Excluding the bottom-land types, it is the most drought-resistant soil in the county. Like the Grundy silt loam, this type was originally covered with prairie grasses.

Over 90 per cent of the Carrington silt loam is under cultivation. Corn is the most important crop and in seasons with a favorable distribution of rain it does well. Ordinarily yields range from 30 to 40 bushels an acre, though in dry years they are much lower. Wheat ranks second in acreage and is being gradually extended. In normal seasons it produces from 15 to 25 bushels an acre, and occasionally as much as 30 bushels. Oats do well but are sometimes injured by hot winds or drought before maturity. Oats produce 25 to 35 bushels an acre, and in very favorable years 40 to 50 bushels. Alfalfa does very well and gives 2 to 4 cuttings, depending on the distribution of the rainfall. The yields range from 3 to 5 tons per acre. In recent years very little timothy and clover have been grown, owing to the difficulty of obtaining a stand. With a favorable distribution of rainfall during the summer months these crops are successful, yielding from 1½ to 2 tons per acre. As there usually is a shortage of rainfall during this period, alfalfa is taking the place of timothy and clover. Timothy is grown alone for both hay and seed, and generally does well. Some prairie grass is cut for hay, the ordinary yields ranging from 1 to 1½ tons per acre. Kafir gives very good results on this type, yielding from 3 to 4 tons of fodder and from 30 to 50 bushels of seed per acre. Some sorghum is grown, the greater part being used for fodder, some as forage for stock, and a small quantity for seed. Only a few fields of kafir or sorghum are seen. Some potatoes are grown but usually not enough for home use. The tendency on this soil is to grow less corn and more wheat and alfalfa, and to keep more live stock.

Owing to its heavier surface soil, the Carrington silt loam is somewhat more difficult to handle than the Grundy silt loam. If plowed when wet it bakes and forms clods that are rather difficult to reduce. Small checks and cracks form on this type, but not to a sufficient extent to cause any serious loss of moisture by evaporation. Where the land is disked before listing for corn it withstands drought fairly well. Manure is usually applied on land to be planted to corn. Occasionally it is used as a top dressing on winter wheat, and as a rule materially increases the yield.

The value of farm land on the Carrington silt loam ranges from $80 to $140 an acre, depending on location and improvements.

*Carrington silt loam, flat phase.*—The soil of the Carrington silt loam, flat phase, consists of a dark-brown, heavy silt loam, 8 to 12

inches deep, which changes abruptly to a compact, tough, moderately crumbly, dark-brown to nearly black or dark-drab silty clay, faintly mottled with light brown. At 24 to 30 inches the subsoil changes to a yellowish-gray silty clay to silty clay loam. The lower subsoil is compact though moderately friable, and not as tough as the upper subsoil. The upper layer is termed a hardpan by the farmers, and where it occurs near the surface it is referred to as "gumbo." The lower subsoil is occasionally high in lime, which occurs chiefly in the form of concretions. The surface soil is friable and rich in organic matter.

This phase is an intermediate soil between the Carrington and the Grundy, and is identical in the soil profile with the Grundy silt loam, except that it carries a few pebbles and is derived from drift instead of loess. Another difference is that the Grundy silt loam occupies the original constructional surface of the county, whereas the flat phase of the Carrington silt loam occupies lower lying, flat areas.

The phase is inextensive. Two areas occur 4 miles north of Pickrell, one northeast and two east of Holmesville, five in the vicinity of Liberty, and one on the Kansas State line. A number of areas too small to be mapped separately are encountered in the typical Carrington silt loam. The phase occupies almost flat to gently undulating land, with a slight dip toward the main streams. Drainage is in most cases adequate. Like the Grundy silt loam, it is not so drought resistant as the typical Carrington silt loam, owing to the hardpan layer. The material is derived from drift flats which are very similar to the loess plains. It originally was covered with a thick growth of prairie grasses.

The agricultural methods on this phase are similar to those on the typical Carrington silt loam. Owing to its flat topography, it is easier to manage, and in seasons of favorably distributed rainfall crop yields are higher.

The value of this land ranges from $90 to $150 an acre, depending on the improvements and location.

### Shelby Series.

The soils of the Shelby series are predominantly brown, though they range to yellowish brown or yellowish gray. The subsoils are composed of yellow, reddish-yellow, or light-brown, tenacious sandy clay. The subsoil frequently contains iron pipes and nodular masses and streaks of calcareous material. These soils are derived from the Kansan drift and occupy steep stream slopes and narrow divides. They are subject to extensive erosion. In Gage County the Shelby loam only is recognized.

SHELBY LOAM.

The surface soil of the Shelby loam consists of a dark-brown to brown, heavy loam, 8 to 12 inches deep. It is friable and fairly high in organic matter, though not so dark in color as the Carrington silt loam. The soil is underlain by a brown, gritty clay loam, which passes abruptly into a brown, tough, gritty clay, mottled with rusty brown, yellow, and gray. At 24 to 30 inches the color of the subsoil changes to yellow mottled with brown and gray, the gray becoming more conspicuous with depth. The lower part of the subsoil is less tough and somewhat lighter in texture than the upper part, and is usually highly calcareous. Iron stains are common and become more conspicuous with depth. Gravel and a few bowlders are encountered on the surface and to a less extent throughout the soil section. Occasionally the subsoil is so gravelly as to be impenetrable with the soil auger, and in places the type is too stony for cultivation.

In places, especially in the southern part of the county, in the vicinity of the Dakota and Permian formations, a variation of this type having a reddish subsoil occurs. It consists of a loam, brown in color and 6 to 8 inches deep, underlain by a reddish-brown, gritty clay loam. Frequently considerable chert and Permian limestone are present in the soil. Immediately north of Beatrice, along Indian Creek, a similar variation with a light-textured subsoil is encountered. The soil is a dark-brown loam, 8 to 10 inches deep, containing a relatively high percentage of fine sand, and underlain by a reddish-yellow loam, which becomes lighter in color and texture with depth. The lower part of the subsoil is quite sandy.

In secs. 9 and 16, T. 3 N., R. 6 E., a variation with a high percentage of very fine sand occurs. The soil is a medium-brown silt loam, containing a high percentage of very fine sand. It is underlain by a reddish-yellow silty clay loam, which, at 24 to 30 inches, passes into a pale-yellow very fine sand. Spots closely resembling this variation are encountered along the creek in the Shelby loam about 3 miles due north of Ellis. The soil of these spots is a gray very fine sandy loam, 6 to 8 inches deep, passing abruptly into a pale-yellow to light-gray very fine sandy loam. This soil is apparently an eroded phase of the sandy development.

A shallow variation of the Shelby loam, which is indicated by the conventional rock outcrop symbol, is encountered in the southern part of the county. The bedrock is very near the surface and exposures are numerous. The soil is too stony and ledgy for cultivation and is used entirely for pasture. Two miles south of Liberty the surface is covered with glacial bowlders, which also are indicated by the rock outcrop symbol. Not uncommonly the soil is nothing more than a thin veneering of drift overlying the bedrock, with a

concentration of bowlders and stony material. In places the bedrock, largely red and grayish shale, has given rise to small areas of soils which differ from the main type, but which can not be indicated on the map on account of their small extent.

In the vicinity of Clatonia and in scattered spots a variation with a friable subsoil is included with the Shelby loam. The soil is a brown to dark-brown loam, 6 to 8 inches deep, passing gradually into a brownish or yellowish, friable, heavy loam to clay loam. The lower subsoil is somewhat lighter in texture and color, and even more friable, and is highly calcareous, the lime occurring chiefly as marly deposits in joints and seams and as concretions. Light-gray and rusty-brown mottlings are quite common.

The most important variation is in the vicinity of Adams. It occurs as small spots throughout the Shelby loam in parts of T. 6 N., R. 7 E. and R. 8 E. The surface soil to a depth of 8 to 15 inches is a dark-brown sandy loam carrying a high percentage of medium and coarse sand and some fine gravel. Where erosion has been active, most of the surface soil is removed and the reddish-yellow sandy subsoil is exposed. Typically the soil is underlain by a reddish-brown, clayey sandy loam, which at 24 to 30 inches passes into a yellowish, sticky coarse sandy loam, with a reddish shade. When dry the sand is loose and incoherent. The soil is low in organic matter. This sandy variation occurs on the lower slopes of the Shelby loam along the Big Nemaha River and its tributaries. It is very droughty and does not support a good growth of grasses, nor do grain crops do so well as on the typical Shelby loam. Most of it is used for pasturage, owing to its steep topography and sandy texture. The material is derived from the Aftonian sands which underlie the Kansan drift. It is similar to the Thurston sandy loam mapped in Seward County, but is less extensive.

Throughout the Shelby loam small areas of eroded soils occur. They are light colored and almost devoid of organic matter. Along intermittent streams the black soil has accumulated to a considerable depth.

The Shelby loam differs from the Carrington silt loam mainly in having a high stone content. Typically the latter has a smooth, rolling topography, whereas the former occupies steep, eroded slopes along drainage ways. The Shelby loam occurs in numerous small areas scattered throughout the county, but is less extensively developed in the northern part than elsewhere. The largest and most typically developed areas are northwest and north of Liberty. The type usually occurs on northward slopes, where the steepness of the slope has prevented the marked accumulation of silty material from the higher lying silt formations.

The material is derived through weathering from the Kansan drift sheet, and has been more or less influenced by the higher lying silt layers. The sand in the soil is chiefly quartz. The bowlders are mainly Sioux quartzite, granite, greenstone, and flint, with some Dakota sandstone and Permian limestone in places.

The native vegetation of the Shelby loam consists of the prairie grasses common in the region. Along the larger streams the slopes were originally forested, mainly with scrub oak, and where the timber has not been disturbed it has encroached upon the prairie areas. About 2 per cent of the type is still in forest.

Owing to its steep topography, eroded surface, and high stone content, only a small proportion of the type is under cultivation. It supports a luxuriant growth of grasses, which afford good pasturage, and is the principal grazing soil of the county. About 25 per cent of the type is devoted to staple crops. Where the slopes are moderate, corn, wheat, and oats do well. Corn yields 15 to 35 bushels, oats 20 to 30 bushels, wheat 15 to 20 bushels, and alfalfa 2½ to 4 tons per acre. A large part of the type is in native hay, which yields ordinarily about 1 ton per acre.

This soil can not be cultivated under so wide a range of moisture conditions as the Carrington silt loam, except where it includes considerable sandy material, and if handled when too wet it bakes and forms hard clods. In areas in which the heavy subsoil is exposed, large checks and cracks are common. As in the case of the other soils of the county, very little barnyard manure and scarcely any commercial fertilizer are used.

The value of this land ranges from $40 to $80 an acre, depending largely on the topography and the stone content of the soil.

### Lancaster Series.

The soils of the Lancaster series are dark brown to brownish gray and the subsoils yellow to gray. The series is residual from sandstone or is derived from sand beds of both glacial and eolian origin. The topography is rolling to hilly. The soils are thoroughly drained and are not retentive of moisture. Only the Lancaster fine sandy loam is recognized in this survey.

### Lancaster fine sandy loam.

The soil of the Lancaster fine sandy loam is a light-brown to medium-brown or rusty-brown fine sandy loam, with an average depth of 6 inches. It is underlain by a somewhat sticky, rusty-brown to brown fine sand, which becomes lighter in color with depth and not infrequently is bright yellow in the lowest part. When

dry the subsoil is loose and incoherent, and where the sandstone has not weathered it is too hard to permit penetration with the soil auger. Where the rock is resistant to weathering scarcely any soil has formed, but where it is soft it has given rise to a deep sandy soil. Over the hard sandstone the soil is heavier and approaches a loam in texture. On the lower slopes it is considerably deeper, ranging from 20 to 24 inches in depth, and contains more silt and organic matter. In places the soil is a light-brown fine sandy loam, underlain by a light-yellow to light-gray fine sand. As a whole it is low in organic matter, the dark color being due in part to the large percentage of iron which it contains.

This type is inextensive; it has a total area of 512 acres. One minor area occurs 1½ miles southwest of Adams, a number southeast of Beatrice, and several north of Lanham. The type occupies eroded hills and gentle slopes along streams. The areas southeast of Beatrice comprise very steep slopes, locally termed the "Iron Mountains." The small area near Adams has a moderate slope, and the same is true of those north of Lanham, with the exception of the three areas 4 miles north of that place, which are similar to those near Beatrice.

The soil is thoroughly drained, but is not subject to excessive erosion, owing to the resistant character of the rock on the steep slopes. It is very droughty and crops suffer severely from lack of moisture.

The material is derived in place from the Dakota sandstone, slightly modified by glacial action. It contains extraneous materials, of which Sioux quartzite and granite are the most important. In general, the soil carries too many remnant bowlders and includes too many outcrops of the parent rock to be of much agricultural value, and it is used almost entirely for pasture. It affords fairly good pasturage in the early spring, but with the approach of hot weather the grass dies and lies dormant until the next spring. A few of the small areas in the southwestern part of the county are under cultivation. Owing to the fact that the soil is very unretentive of moisture, the yields of corn, wheat, and oats are low.

Farm land of this type is valued at $40 to $60 an acre, depending on the stone content and the location.

### Scott Series.

The soils of the Scott series are dark brown to drab. The upper subsoils are lighter in color than the surface soils, usually gray, and range in thickness up to 6 inches. They are underlain by a tough, plastic clay layer, dark drab and brown mottled, ranging in thickness from 5 to 15 inches. At about 30 inches there is a gradual change to a lighter colored, friable, somewhat lighter textured layer

extending to the bottom of the 3-foot section. These soils consist of lake-laid material eroded from higher lying loessial soils and deposited by sheet surface waters or intermittent streams in the shallow waters of temporary lakes or ponds occupying local, undrained, sinklike depressions in upland plains. They are poorly drained and in places are subject to overflow. The Scott series is represented by the silt loam type in Gage County.

### SCOTT SILT LOAM.

The Scott silt loam consists of a dark-brown to dark-gray, smooth silt loam, 6 to 15 inches deep, carrying a rather high percentage of organic matter. The soil is very friable and has a decidedly velvety feel. It has a distinctly grayish cast when dry, in contrast with the associated Grundy and Waukesha silt loams. The upper part of the subsoil is a light-gray, friable silt loam, ranging from 1 inch to 6 inches in depth. This changes abruptly into a black to dark-drab, hard, tough, moderately plastic silty clay, which becomes mottled with brown at lower depths. At 20 to 36 inches the subsoil becomes lighter in texture and grayish in color. Occasionally lime concretions are encountered in the lower part of the subsoil. Where the upper stratum of the subsoil is thick there is usually no change in color or texture in the lower subsoil. In the areas of Scott silt loam within the Grundy silt loam the light-gray upper subsoil either is absent or is present in only a very thin layer. The areas associated with the Waukesha silt loam have a deeper layer, typical of the main type.

The Scott silt loam is unimportant in Gage County, covering only 64 acres. It occurs in association with the Waukesha silt loam in the vicinity of Beatrice and on the loess plains. It occupies slight depressions which are not nearly as deep as the typical Scott basins in Seward County. The drainage is poor and in the spring after heavy rains water stands on the ground for periods ranging from a few days to several weeks.

The soil of the upper section apparently is derived from silt washed in comparatively recent times from the surrounding higher land and deposited over an older soil which now constitutes the lower subsoil. The lower stratum, which is high in organic matter, is apparently a very old soil formed by the sifting in of clay and silts from standing water.

The native vegetation consists of sedges and water-loving plants, with prairie grasses along the border of the type. Only a few areas have been reclaimed and are devoted to the production of staple crops. Where the soil is provided with adequate drainage, corn, small grains, and even alfalfa do well. In its natural condition the best

use of this type is for grazing and it is largely utilized for this purpose at the present time. It is not a good soil for grain farming.

The Scott silt loam is valued at $40 to $60 an acre as farm land, depending largely on the drainage conditions.

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

*Mechanical analyses of Scott 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.* |
| 371319 | Soil | 0.1 | 1.0 | 0.6 | 1.6 | 9.2 | 72.3 | 15.1 |
| 371320 | Subsoil | .4 | 1.0 | .6 | 1.6 | 10.4 | 68.8 | 17.1 |
| 371321 | Lower subsoil | .1 | .2 | .2 | 1.9 | 7.1 | 57.0 | 33.2 |

## WAUKESHA SERIES.

The surface soils of the Waukesha series are dark brown to black; the subsoils are yellow. These soils occur in areas of deep glacial drift. They are derived from water-assorted glacial débris deposited in broad, filled-in valleys or as outwash plains and terraces. The topography is mainly flat to undulating, and drainage is good. In Gage County the silt loam type only is mapped.

### WAUKESHA SILT LOAM.

The soil of the Waukesha silt loam is a dark-brown to nearly black, heavy silt loam with a depth of 8 to 15 inches, the depth probably averaging 12 inches. The soil is friable and rich in organic matter, as the prevailing dark-brown color indicates. The upper part of the subsoil consists of a nearly black to dark-drab or dark-brown to brown, hard, tough, moderately crumbly silty clay. This stratum is usually faintly mottled with lighter brown, often having a reddish tint. When wet it is rather plastic and sticky. It varies from 12 to 18 inches in thickness and is referred to as a hardpan layer. Where it lies near the surface it is spoken of as "gumbo." The lower subsoil, which is encountered at depths ranging from 18 to 30 inches, is a yellowish-brown silty clay loam to clay, becoming lighter in color with depth. Occasionally the yellowish-brown stratum is very thin or is replaced by grayish-yellow material. The lower subsoil is evidently friable and not nearly so hard or tough as the upper subsoil. Lime concretions are common in the lower part of the soil profile. The change from soil to subsoil is abrupt, and the upper part of the subsoil is heavier than the lower, the same change taking place as in the Grundy silt loam or in the flat phase of the Carrington silt loam.

On the slopes of terrace fronts or on slopes along streams dissecting the terraces or slight elevations the soil profile is similar to that of the Carrington silt loam. There is no abrupt change from soil to subsoil, though there is a concentration of clay in the upper part of the subsoil. On the lower slopes the subsoil frequently has a reddish-brown color. This variation is not indicated on the map, though soils having a relief similar to the upland soils are classed with the latter. A number of areas of old eroded terraces occur on the east side of Indian Creek, east and north and south of Pickrell.

The Waukesha silt loam is a rather extensive type, covering 57.2 square miles. It occurs as a high and low terrace, mainly north of Wymore along the Big Blue River. The type has a flat, benchlike topography, and the drainage is poor. The areas are more or less dissected by branches entering the main streams. The transition from the upland to this terrace soil is marked, as a rule, by a very gentle slope, and in places it is so indefinite that the boundary line is necessarily somewhat arbitrary. The slope from the Waukesha silt loam to the bottom land is usually moderate, though very distinct, except where the type occurs on the lower terrace, where it is rather obscure.

In secs. 28, 29, 32, and 33, T. 3 N., R. 7 E., the type is more rolling, and it is questionable whether it should be mapped as an upland or a terrace soil. In general it is flat, though in detail it has been more or less reduced to gentle slopes by stream erosion. As a whole the drainage is good.

This type does not withstand drought as well as the Carrington silt loam, owing to the hardpan layer, which prevents the free capillary movement of the ground water.

Originally the Waukesha silt loam was covered with a thick growth of prairie grasses. About 95 per cent of it is utilized for the production of the crops commonly grown in the region, and it is considered one of the best soils in the county. Corn is the principal crop and does well, except in dry years, the ordinary yields being 30 to 35 bushels an acre, while under very favorable conditions yields of as much as 60 bushels are often obtained. Wheat ranks second in acreage, and its production is being gradually extended. In normal seasons it yields 20 to 25 bushels per acre, though yields of 36 bushels were reported during the progress of the soil survey. Oats are grown occasionally, and ordinarily produce about 30 bushels per acre, though in seasons of ample rainfall 50 bushels are obtained. Considerable alfalfa is grown. Ordinarily 3 cuttings, and sometimes 4, are obtained in a season, with a yield of 3 to 5 tons per acre. Irish potatoes are grown for home use, yields ranging from 50 to 100 bushels per acre. Some sorghum is grown, and the crop does well.

Very little attention is given to crop rotation, particularly in the case of tenant farmers. The methods of cultivation and fertilization are similar to those on the Grundy silt loam. The "gumbo" spots are greatly benefited by heavy applications of barnyard manure. This soil is gradually decreasing in productiveness.

Farm land of the Waukesha silt loam ranges in value from $100 to $150 an acre.

Below are given the results of mechanical analyses of samples of the soil and subsoil of this type:

*Mechanical analyses of Waukesha 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.* |
| 371307 | Soil | 0.0 | 0.2 | 0.4 | 0.8 | 7.6 | 69.4 | 21.6 |
| 371308 | Subsoil | .0 | .4 | .3 | 1.8 | 9.0 | 58.6 | 30.1 |

## Sioux Series.

The Sioux series comprises dark-brown to black terrace soils overlying lighter colored, calcareous subsoils. The subsoils are underlain by a substratum of gravel at varying depths. These soils occur in the glaciated region of the northwestern Great Plains. In Gage County the series is represented by the sandy loam type.

### Sioux sandy loam.

The Sioux sandy loam consists of a brown sandy loam, 6 to 8 inches deep, containing a relatively high percentage of medium and coarse sand. It is underlain by a light-brown sand, which, at depths ranging from 18 to 24 inches, passes into a brownish-yellow or yellow sand. The soil is loose and incoherent, though slightly sticky when wet. The percentage of organic matter in the surface soil is not high.

This type has a small extent, and occurs as narrow bands in association with the Waukesha silt loam along the Big Blue River. It occupies the high terrace fronts and stream slopes of the terraces. The slopes are moderately steep to abrupt where the soil immediately overlies bedrock. Where the rock outcrops it is shown by the conventional rock outcrop symbol. The soil is excessively drained, and crops suffer severely from lack of moisture even in seasons of normal rainfall.

The Sioux sandy loam is derived from the basal sands of the high terraces along the Big Blue River. The sands are stratified, and consist largely of feldspathic and quartzitic medium sand, with an admixture of coarse sand and fine gravel.

A part of the type formerly supported a growth of scrub oak and the other part a growth of native prairie grasses. About 50 per cent of it is under cultivation, the remainder being largely in permanent pasture. Wheat is apparently the most important crop, with a reported average yield of 15 bushels per acre. Corn does not do well, and is likely to "burn" during the hot weather of the growing season. It yields from 10 to 15 bushels an acre. Oats do fairly well and ordinarily yield from 20 to 25 bushels per acre. Some alfalfa is grown, and is fairly successful, yielding 2 to 3 tons per acre. No systematic rotation is practiced on this type, and the general tendency is to grow as much wheat as possible.

Owing to the sandy texture of the soil, it is easy to handle and can be worked under a wide range of moisture conditions. Considerable barnyard manure is applied either on the land for corn or as a top dressing on winter wheat. This land is valued at $40 to $60 an acre, depending mainly on the topography.

### Wabash Series.

The Wabash soils are prevailingly black, ranging to dark brown, and contain a high percentage of organic matter. The subsoils are gray to brownish gray. These soils are developed in the first bottoms of streams in the Central Prairie States. They extend for long distances along the Mississippi River. The material is derived principally from the loessial and associated soils of the region. These soils have a flat topography and are poorly drained. Only the silt loam of the Wabash series is mapped in Gage County.

### Wabash silt loam.

The Wabash silt loam to a depth of 18 to 24 inches is a dark-brown to black, very friable silt loam carrying a high percentage of organic matter. It is darker than the Grundy silt loam and has the decidedly velvety feel characteristic of soils high in silt. The subsoil is of the same color as the surface material, but heavier and more compact, being in places a silty clay loam. Usually faint mottlings of brown and gray appear in the lower part of the subsoil. Over a large part of the type there is no marked difference in color or texture within the 3-foot section.

On the narrow, low first bottoms along the large streams the soil is an almost black silt loam, 12 to 18 inches deep, underlain by a light-gray silt loam, which at 24 to 30 inches passes into a heavy silt loam. Frequently the gray subsoil continues throughout the 3-foot section, as in the case of the Wabash silt loam on the higher, poorly drained first bottoms. There are a few scattered depressions, locally called "wet spots" or "gumbo," associated with the type. The soil

in such places is a heavy silt loam to silty clay loam, with little change in the 3-foot section, though usually somewhat lighter in color and slightly mottled with brown in the lower part. Owing to the impervious character of the soil in such places, water stands on the surface longer than on the typical soil. Crops do not do well in these depressions.

Where the Wabash silt loam occurs in association with the Shelby loam, especially in the more sandy areas, it has been influenced considerably by sand washed from the Shelby type. The soil in such places is a dark-brown sandy loam to loam, from 8 to 12 inches deep, underlain by a gray, light-textured loam containing seams of pure fine sand. At 20 to 40 inches a black heavy loam with a low sand content is encountered. This variation, which occurs largely in the vicinity of Adams, is too inextensive to map as a separate phase.

Included with the Wabash silt loam are areas of colluvial material in which the soil is a dark-brown to black, heavy silt loam, with little change in texture or color within the 3-foot section, the lower part being more compact. They occupy a position between the upland and bottom-land soils and in a few instances occur along intermittent streams where there has been considerable side-hill wash. These areas have an appreciable slope and are well drained. In all cases they consist of material which has been deposited mainly near the source of the streams. Where the soil is derived from wash brought down by the small streams of high gradient heading in the sandy drift it has a considerable admixture of sand and coarse material. It consists of alternate layers of fine and coarse material, ranging from dark brown to brown in color. Practically all of this colluvial soil is devoted to the production of corn, though some wheat and oats are grown. Corn yields from 45 to 60 bushels per acre.

The Wabash silt loam is the most important bottom-land soil in the county, covering 126.3 square miles. It occurs as the higher first bottoms and as narrow, low first bottoms along the main streams, except along the Big Blue River, where the first bottoms are occupied by the Sarpy very fine sandy loam and Meadow.

The type has a flat topography and is only slightly dissected by cut-offs and old stream channels. In general it lies 10 to 20 feet above the normal flow of streams, except in the low first bottoms, where it is only 4 to 5 feet above.

Originally the drainage of this type was rather inadequate, but by cleaning the channels and clearing the land the conditions have been greatly improved. Now, with the exception of local areas, the drainage is good, except during the high stages of the streams. The areas along the Big Nemaha River as a rule are overflowed annually, but since the drainage ditches have been installed along the lower course

of the river floods are seldom of longer duration than 3 or 4 hours. The other areas are only occasionally inundated, except where subject to overflow by small branches.

The bottom lands along the minor streams and a narrow strip along the main streams, varying from 4 to 40 rods in width, support a native forest growth of oak, elm, ash, box elder, soft maple, cottonwood, black walnut, hackberry, bitter hickory, sycamore, willow, coffee bean, and dogwood. According to observations made during the progress of the soil survey, there are approximately 8,200 acres, or about 16 per cent of the total area of the type, in forest. Only a small percentage of the timber has been cut. The greater part of the type was originally covered with a luxuriant growth of wild grasses.

About 80 per cent of the Wabash silt loam is under cultivation and is used for the production of staple crops. It is considered the best agricultural soil in the county, and as a rule crop yields are 20 to 50 per cent higher on this type than on the upland soils. Corn is the dominant crop. It yields ordinarily from 40 to 50 bushels per acre, and in favorable seasons, with thorough tillage, as much as 70 to 90 bushels. Where the soil has been devoted to the production of corn for a number of years and its productiveness has been lowered wheat does well, yielding ordinarily 25 to 30 bushels, and in favorable seasons as much as 40 bushels, per acre. Where the soil is very productive wheat is likely to lodge and give low yields. Kherson oats do well on this type, yielding from 35 to 50 bushels an acre, but the long-strawed oats are likely to lodge, except where the productiveness of the soil has been materially reduced by cropping. Neither wheat nor oats are grown extensively, but the acreage of wheat is being gradually extended. Except in some poorly drained areas, alfalfa does well and in normal seasons gives 3 or 4 cuttings, with a total yield of 3 to 6 tons per acre. This legume makes a more luxuriant growth on this soil than on any other type in the county. Occasionally the second growth is used for seed, yields of 3 or 4 bushels an acre being obtained. Only a small part of the type is in grass, which yields from 1 ton to 2 tons of hay per acre, depending on the distribution of the rainfall. Timothy and clover do well in wet seasons, yielding from $1\frac{1}{2}$ to $2\frac{1}{2}$ tons of hay per acre. Usually enough potatoes are grown for home use.

Owing to its flat topography, silty texture, and friable structure, this soil is very easy to handle and crops seldom suffer from lack of moisture, even during protracted droughts. The type can be cultivated under a wider range of moisture conditions than either the Grundy or Carrington silt loams and seldom bakes or clods, except in the "gumbo" spots, which are difficult to till.

The productiveness of the soil has slightly decreased owing to the one-crop system of farming. Scarcely any barnyard manure and no

commercial fertilizers are used. A rotation of corn, oats, and wheat appears to maintain the productiveness of the type.

The value of farm land on this type ranges from $100 to $200 an acre, depending on the location and liability to overflow.

### Sarpy Series.

The soils of the Sarpy series range from light gray to brown. They differ from the Wabash and Yazoo soils in color and in having subsoils distinctly lighter in texture than the surface soils. This series is developed in the bottoms of the Mississippi and Missouri Rivers and their larger tributaries. The material is alluvial in origin. Owing to their low position, the soils are subject to overflow, although the nature of the soil and subsoil is such that between the flood stages of the streams drainage is good. In general, the topography is flat. The Sarpy very fine sandy loam is identified in Gage County.

### Sarpy very fine sandy loam.

The soil of the Sarpy very fine sandy loam consists of a light-brown to brown, and occasionally dark-brown, very fine sandy loam, 8 to 18 inches deep, carrying a relatively high percentage of silt. It is underlain by a yellowish-gray to light-gray, somewhat loose and porous very fine sandy loam. The line of demarcation between soil and subsoil is rather indistinct. Layers of silt and coarser material are not uncommon throughout the soil section. As the color indicates, the soil is not very high in organic matter. The boundary line between the Sarpy very fine sandy loam and the Wabash silt loam as a rule is not marked by any physiographic change, and the separation on the map is more or less arbitrary.

This type is inextensive, and is confined to the first bottoms along the Big Blue River and Turkey Creek. It is best developed south of Holmesville, where it occurs in a strip from one-eighth to almost a mile in width along the Big Blue River. Northwest of Holmesville the areas are narrow and discontinuous.

The type lies 10 to 15 feet above the normal flow of the Big Blue River, or at about the same level as the Wabash silt loam, and occasionally lower. Along Turkey Creek the elevation above the stream is somewhat lower. The areas have a generally flat topography, but are more dissected by overflow channels and cut-offs than the Wabash silt loam. The drainage is thorough and, except in the lower "sags," the type is only occasionally overflowed. As a whole the soil withstands drought well and crops seldom suffer from lack of moisture.

A large proportion of the type was originally covered with a growth of ash, elm, oak, cottonwood, willow, black walnut, and hack-

berry. About 80 per cent of it is under cultivation. Corn is the principal crop grown, the average yield being 40 bushels per acre. Considerable wheat is grown and the acreage of this crop is being gradually increased. Wheat does well, yields of 20 to 25 bushels an acre being obtained. Oats do very well, the ordinary yields ranging from 25 to 30 bushels per acre, while in favorable seasons, with proper cultivation, yields run as high as 75 bushels. Alfalfa is the principal hay crop, and in normal seasons three or four cuttings are made, with a total yield of 4 to 6 tons per acre. Irish potatoes do well and yield from 125 to 150 bushels an acre without special fertilization or thorough cultivation. Sweet potatoes yield from 140 to 160 bushels per acre. Both potato crops are grown primarily for home use, though a small quantity is sold.

The general plan on this type seems to be to keep the land in corn 4 to 5 years, in oats 1 year, and in wheat 2 to 4 years. As a rule not much attention is given to definite and systematic crop rotation, and frequently corn is grown continuously on the same land for 10 years or more and wheat for 5 years or more. The tendency is to grow more wheat and alfalfa and less corn.

Owing to its light texture, this soil is easy to handle and can be worked under almost any moisture condition, provided no water is standing on the ground. More manure is applied to this soil than to the Wabash silt loam.

Land of this type ranges in value from $100 to $140 an acre, depending on the location and improvements.

### Cass Series.

The surface soils of the Cass series are dark brown to black; the subsoils are lighter in color and texture. These soils are alluvial and are most extensively developed in the bottoms along the Mississippi and Missouri Rivers and their tributaries. They occur in association with the Sarpy soils and differ from them only in their darker color. In Gage County only the silt loam member of the series is mapped.

#### CASS SILT LOAM.

The soil of the Cass silt loam is a dark-brown to nearly black silt loam, 12 to 18 inches deep, carrying a high percentage of organic matter. It is underlain by a yellowish-gray to light-gray, very fine sandy loam, with a high percentage of silt. Seams of coarser material and of silt are not uncommon in the subsoil. This type differs from the Wabash silt loam in having a light-colored and light-textured subsoil.

This type is inextensive, having a total area of only 1.1 square miles. It occurs in the northwestern part of the county on the Big

Blue River first bottoms and extends along Turkey Creek into Saline County. The topography is flat. Owing to its sandy subsoil the type is well drained.

Originally the most of this type was covered with grasses. There is a narrow strip along Turkey Creek and the Big Blue River which is forested. Practically all of the type is under cultivation. Corn is the principal crop, and ordinarily yields 40 to 45 bushels an acre. Considerable wheat and oats are grown, and good yields are obtained. The long-strawed oats are likely to lodge. Barnyard manure is applied to this soil in small quantity. No commercial fertilizer is used.

The type is rather easy to handle and can be worked under a wider range of moisture conditions than the Wabash silt loam, owing to the light-textured subsoil.

The value of farm land on this type ranges from $125 to $150 an acre, depending on the improvements.

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

*Mechanical analyses of Cass 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.* |
| 371322 | Soil | 0.0 | 0.2 | 0.2 | 0.4 | 11.2 | 67.3 | 20.9 |
| 371323 | Subsoil | .0 | .1 | .2 | 2.3 | 17.2 | 66.6 | 13.4 |

## MISCELLANEOUS MATERIAL.

### MEADOW.

Meadow comprises small, narrow strips of low first-bottom land along the Big Blue River. It is poorly drained and lies only 4 or 5 feet above the normal flow of the stream. It is subject to frequent inundation, with the addition of deposits in certain places and the washing away of the soil in others. The material ranges from a fine sandy loam to a very fine sandy loam or silt loam, and in places to a heavy silt loam or silty clay loam. The soil is usually 15 to 18 inches deep and ranges from light brown to black in color. It is generally underlain by lighter textured material, usually a very fine sandy loam and sometimes a fine sandy loam, of a yellowish-gray or light-gray color. This type is really a mixed loam of the Sarpy and Cass series.

Practically all of the type is forested, the timber growth consisting chiefly of elm, ash, oak, cottonwood, and willow, with some black walnut and box elder. It is used for grazing.

SUMMARY.

Gage County is located in the southeastern part of Nebraska and adjoins the Kansas State line. It has an area of 856 square miles, or 547,840 acres. The topography ranges from almost flat or plain-like to rolling, with steep to abrupt slopes along drainage ways, bordered by rather high rock ledges.

As a whole the county is well drained, the greater part of it through the Big Blue River.

The first permanent settlement in Gage County was made in 1855, and the county was organized in 1857. The early settlers came largely from the Eastern States, and a large number of the later settlers were foreigners. The population of the county is reported in the 1910 census as 30,325. Beatrice, the county seat, lies 3 miles west of the geographic center of the county, and has a population of 9,356.

The county has good transportation facilities, no part of it being more than 9 miles from a railroad station.

All sections of the county are supplied with rural mail delivery and telephone service.

The climate is favorable for the growing of corn, wheat, oats, and alfalfa and other forage crops. The mean annual precipitation is reported as 29.87 inches, and the mean annual temperature 51.2° F.

Grain farming is the chief type of agriculture, though increasing attention is being given to the production of beef, pork, and dairy products.

Corn, wheat, oats, wild grasses, alfalfa, timothy, and clover are the principal farm crops. Millet, sorghum, kafir, sweet corn, and potatoes are grown to a small extent. Truck crops are produced on a small scale. There are a few commercial fruit orchards in the county, mainly in the vicinity of Beatrice.

The adaptation of soils to crops receives but little attention, and definite and systematic crop rotations are not practiced.

Excluding Meadow, 10 soil types, representing 10 series, are mapped in Gage County. These are classed in three groups—the upland, terrace (old-alluvial), and first-bottom (recent-alluvial) soils.

The Grundy silt loam is a dark-colored loess soil, and represents remnants of the original constructional surface of the county. This soil is generally considered the best upland soil in the county. It is used principally for the production of corn, wheat, oats, and alfalfa.

The Carrington silt loam is glacial in origin and is derived from a weathered layer of the Kansan drift. It is the predominant upland soil and covers slightly more than one-half the county. Corn, wheat, oats, and alfalfa are the principal crops grown. The flat

phase of this type is similar to the Grundy silt loam, though of glacial origin. The same crops are produced on this phase as on the main type.

The Shelby loam is glacial in origin, but is derived from typical till containing a high percentage of sand, pebbles, and bowlders. It is largely used for grazing land, though where the slope is not too steep and the stone content is low corn, oats, wheat, and alfalfa do well.

The Lancaster fine sandy loam is derived in place from the Dakota sandstone. Owing to its steep topography, stony character, and sandy texture it is not well adapted to grain farming. It is largely used for pasture.

The Scott silt loam occurs in slightly depressed areas in association with the Grundy and Waukesha silt loams. It is chiefly used for pasture.

The Waukesha silt loam belongs to the terrace group of soils and is admirably adapted to corn, wheat, oats, and alfalfa. In soil profile it is almost identical with the Grundy silt loam and the flat phase of the Carrington silt loam.

The Sioux sandy loam is derived from the basal sands of the Waukesha silt loam. It is very limited in extent and not an important agricultural soil.

The Wabash silt loam is the most important bottom-land soil in the county. It is considered the best agricultural soil in the county, and produces good yields of corn, but is not nearly so well suited to wheat and oats.

The Sarpy very fine sandy loam is a light-colored first-bottom soil with a loose very fine sandy loam subsoil. Practically all of the type is under cultivation and is devoted mainly to corn, wheat, and oats.

The Cass silt loam is an alluvial soil occurring on the first bottom of Turkey Creek and the Big Blue River in the northwestern part of the county. It is used for the same crops as the Wabash silt loam.

Meadow comprises small, low first-bottom strips along the Big Blue River, and includes soils which are too variable in texture and color to be separated satisfactorily into soil types. It is mainly used as grazing land.

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