

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE UNIVERSITY OF NEBRASKA, G. E. CONDRA,
DIRECTOR, NEBRASKA SOIL SURVEY.

SOIL SURVEY OF WAYNE COUNTY,
NEBRASKA.

BY

B. W. TILLMAN, OF THE U. S. DEPARTMENT OF AGRICULTURE,
IN CHARGE, AND B. F. HENSEL, OF THE NEBRASKA
SOIL SURVEY.

THOMAS D. RICE, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1917.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE.

1919.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., June 12, 1918.

SIR: I have the honor to transmit herewith the manuscript report and map covering the survey of Wayne County, Nebr., and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils, 1917, as authorized by law.

This work was done in cooperation with the University of Nebraska.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

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

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MAP.

Soil map, Wayne County sheet, Nebraska.

SOIL SURVEY OF WAYNE COUNTY, NEBRASKA.

By B. W. TILLMAN, of the U. S. Department of Agriculture, In Charge, and B. F. HENSEL, of the Nebraska Soil Survey.—Area Inspected by THOMAS D. RICE.

DESCRIPTION OF THE AREA.

Wayne County, Nebr., lies in the northeastern part of the State, in the second tier of counties west of the Missouri River. It is bounded on the north by Cedar and Dixon Counties, on the east by Dixon and Thurston Counties, on the south by Cuming and Stanton Counties, and on the west by Pierce County. Its extreme length from east to west is 28 miles, and its greatest width from north to south 18 miles. It comprises 450 square miles, or 288,000 acres.

The county comprises three main physiographic divisions, (1) the upland, (2) the terrace, or bench land, and (3) the first-bottom land.

The upland covers about three-fourths of the area of the county. It is extremely uneven, including three types of surface relief, (1) hills, (2) strongly rolling areas, and (3) gently undulating to smooth areas. Although these surface features are more or less irregular in occurrence and are frequently combined in small areas, there are parts of the county in which one or the other character of relief predominates.

The largest continuous belt of hills is southwest of Winside, extending from the Stanton County line east of Humbug Creek to the northwest of Hoskins into Pierce County. Also the northwestern part of the county to the west of Carroll is dotted with hills, but these are interrupted by the predominantly rolling to undulating character of relief. The hills in Wayne County are erosional, that is, they represent portions of the original loess plain that have escaped the wearing down of the region by erosion. In a general way, the hilly belt follows the divide between the Logan Creek drainage system and the Elkhorn River system. This divide is the highest land in Wayne County and from it the streams flow in two general directions, east toward Logan Creek and southwest or west

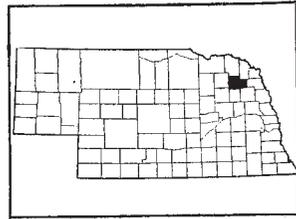


FIG. 1.—Sketch map showing location of the Wayne County area, Nebraska.

toward the Elkhorn River. Drainage in the hilly areas is excessive. The tops of the ridges are narrow, and the slopes rather steep. The streams have cut deep, narrow channels and are still actively eroding. The valleys of the hilly belt are narrow.

The rolling upland extends as a broad belt across the northern two-thirds of the county. The slopes to streams are gradual. The valleys usually are wide. Small streams are numerous but the tops of ridges usually are broad, giving rise to extensive areas of even topography. Drainage is adequate to excessive. In general, the rolling part follows both sides of the Logan Creek Valley, but also extends to the Cuming County line south of Wayne along the drainage systems of Humbug and Plum Creeks. The western part of the rolling belt in the vicinity of Carroll and Winside is higher and more irregular than the eastern part. The western part includes rather prominent isolated hills near streams, such as the elevations 2 miles west of Carroll, where the ridges are narrow and drainage excessive. The valleys, too, are narrow considering their depth. However, the valley of Deer Creek is an exception, its valley being comparatively wide. Fairly extensive deposits of alluvial material form the valley floor of this stream. The most prominent valley is that of Logan Creek, which starts in a network of small streams in the western part of the county and gradually widens as the tributaries converge eastward to form the main channel. The elevation at Sholes in the northwestern part of the county is estimated to be 1,671 feet above sea level. At Wayne in the eastern part it is 1,460 feet, according to the United States Coast and Geodetic Survey, and at Hoskins in the southwestern part it is reported as 1,668 feet.

The gently undulating to smooth upland is in the southeastern part of the county, occupying 75 or 80 square miles. It includes several small flat areas, which are shown on the accompanying soil map as a flat phase of the Marshall silt loam. These areas represent remnants of the original loess plain, which formerly occupied the entire area as well as much of eastern Nebraska. The rolling and hilly areas of the county are eroded from this plain. In the gently undulating to smooth part of the upland the slopes to the streams are gradual. This section in general is less thoroughly dissected than either the rolling or the hilly portions of the county. The topography is constructional rather than destructional, as the streams have not yet made any marked progress in erosion.

The terrace, or second-bottom lands are an important feature in Wayne County. They consist of high, or second terrace and a low, or first terrace. There are three areas of high terrace land, one along the Thurston County line south of Coon Creek, a second 2 miles southeast of Wayne, and another three-fourths mile southwest of

Wakefield. These have a combined area of approximately 6 square miles. The high terrace is estimated to be about 35 feet above the flood plains of the streams. The first, or low terraces are about 15 to 20 feet above the first bottoms. The largest single low-terrace area occurs in the northeastern part of the county at Wakefield. Small, irregular areas occur throughout the county along nearly all the streams, but most prominently along Logan Creek and its tributaries. The topography is predominantly flat except where interrupted by narrow slopes and basinlike depressions. The latter are conspicuous in the area at Wakefield. The slopes to the first bottoms are usually gentle and favorable to successful agricultural operations.

Approximately one-eighth of the county is first-bottom land. The largest areas occur along Logan Creek, but all the small streams have narrow strips of alluvial deposits along their courses. The flood plain of Logan Creek varies in width from one-half to three-fourths mile, while that of the smaller streams rarely exceed one-half mile, except at the points of junction of two streams. The streams usually follow crooked or meandering courses near the center of the valleys. A few cut-offs or horseshoe lakes have been formed in the valley of Logan Creek. The topography is predominantly flat. The elevation of the bottom lands at Wayne is approximately 1,450 feet, and at Winside 1,555 feet above sea level. It is estimated that the upland is about 60 to 70 feet above the first bottoms.

The total range in elevation in the county is probably not much over 200 feet. The highest part is in the northwest and the lowest in the east. The general direction of the drainage, therefore, is to the east, but the southern part of the county drains south and east, while the extreme western part drains southwest. A few small streams along the Cedar County line flow north. Drainage of much of the bottom land is deficient, especially in situations where small streams of the upland issue into the bottoms. Frequently the channels in such situations become clogged and the water spreads over the surface until it evaporates.

Logan Creek is the largest stream in the county, carrying about three-fourths of the drainage. Deer Creek and South Logan Creek rise in the western part of the county, on the eastern slope of the main divide, and join a few miles southwest of Wayne, forming Logan Creek. Coon Creek drains a small area in the eastern part of the county. The southern part of the county is drained by Humbug and Plum Creeks and the northern part by Dog Creek. The main divide extends from the vicinity of Hoskins to Sholes, in the western part of the county. The extreme western part is drained by several small streams of the Elkhorn River drainage system to the west in Pierce County. Small streams ramify into all parts of

the county, so that every farm is connected with one or more of these drainage outlets. The streams have not reached base level and are still actively eroding.

The first white settlers arrived in Wayne County in 1868; shortly thereafter a small colony from Illinois settled in the eastern part of the county along Coon Creek. The county was organized in 1870, and the county seat located at La Port in 1871. It was moved to Wayne, the present county seat, about 1881. The settlers came largely from Iowa, Illinois, Missouri, and Eastern States. Many German families settled in the county about 1875, and a part of the population consists also of Irish, English, Swedes, and Danes. The population is evenly distributed over the county. All the population is classed as rural by the 1910 census, and the total is reported as 10,397, or 23.1 per square mile.

Wayne, the county seat, has a population of about 2,200. It is the home of one of the State normal schools and is the chief distributing point for supplies in the county. Winside, with a population of about 700; Carroll, with about 300; Hoskins, with a population of 250; and Sholes are thriving railroad towns. Wakefield, with a population of about 1,000 is located on the Dixon County line. Altona is a small crossroad village in the southeastern part of the county.

Transportation facilities are good, only the extreme southeastern part of the county being at all remote from a railroad. One branch of the Chicago, St. Paul, Minneapolis & Omaha Railway system traverses the county northeast-southwest through Wayne, Winside, and Hoskins, and another passes through Carroll and Sholes, leaving the county in the northwestern part. These lines afford direct connection with Sioux City, Omaha, and Lincoln, which are the principal markets for the products of the county. Wayne furnishes a good local market for poultry and dairy products, wheat, and corn. All the small railroad towns of the county serve as shipping points from which large quantities of corn and wheat and live stock are sent to outside markets. Although most of the stock goes to Omaha and Sioux City, large numbers of animals are shipped to Chicago.

The county is well supplied with public roads, which follow land lines regardless of topography. The more important roads, such as the highways to the various towns, are well graded and dragged after each rain, thus being kept in smooth condition. However, the minor roads are frequently neglected and are sometimes impassable. Increasing attention has been given recently to the construction of concrete culverts and steel bridges.

All parts of the county are supplied with rural mail delivery, and telephones are in common use.

CLIMATE.

The climate of Wayne County is typical of that of a fairly wide belt along the Missouri River in northeastern Nebraska. The mean annual precipitation is about 28 inches. Of this a little over 11 inches, or about 41 per cent, occurs during the summer season, including the months of June, July, and August, which is the main growing season. The driest months of the year are November, December, January, and February, each having a normal mean precipitation of less than 1 inch. May, June, July, and August have the heaviest precipitation, June being the wettest month, with an average of about $4\frac{1}{2}$ inches. Owing to the light winter precipitation, there is practically no leaching of plant foods from the soil at this season. In the summer the precipitation usually occurs as heavy thundershowers. Torrential rains, however, are rare. Severe droughts are almost unknown during May and June, but during the latter part of July and all of August the rainfall varies considerably, and short dry spells may occur. However, on account of the high water-retaining power of the soils, crops rarely suffer severely for lack of moisture where proper cultural methods are followed.

The mean annual temperature is about 48° F. July is the hottest month with an average temperature over 73°. The mean temperature for the summer months of June, July, and August is about 71° F. December, January, and February are the coldest months, with a mean temperature of about 21°. Extremely cold periods usually are of short duration, although the thermometer may drop to the minimum on four or five mornings a week during the cold spell. The extremes of heat likewise are of short duration and of rare occurrence.

The average date of the last killing frost in the spring, according to the records of the Weather Bureau station at Wakefield, Dixon County, is May 8, and of the first in the fall September 29. The latest recorded date of killing frost in the spring is May 27, and the earliest recorded date in the fall September 4. There is an average growing season of 144 days.

The climate in general favors the production of grain crops and leguminous forage crops, besides a number of excellent pasture grasses. It has been an important factor in the development of the extensive system of general grain and live-stock farming prevailing in the county.

The data in the following table are compiled from the records of the Weather Bureau station at Wakefield, Dixon County, which are representative of climatic conditions in Wayne County. There is no Weather Bureau station in Wayne County.

Normal monthly, seasonal, and annual temperature and precipitation at Wakefield, Dixon County.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year, 1910.	Total amount for the wettest year, 1915.
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	23.2	66	-24	0.87	0.47	0.54
January.....	20.2	62	-41	.59	.42	1.08
February.....	20.2	68	-38	.95	.25	2.96
Winter.....	21.3	68	-41	2.41	1.14	4.58
March.....	34.8	88	-16	1.08	.02	1.26
April.....	48.4	101	12	2.65	.40	2.51
May.....	59.1	97	19	4.08	2.81	6.24
Spring.....	47.4	101	-16	7.81	3.23	10.01
June.....	68.0	101	34	4.46	2.39	4.74
July.....	73.4	107	41	3.25	2.36	7.71
August.....	71.8	104	35	3.63	3.46	1.73
Summer.....	71.1	107	34	11.34	8.21	14.18
September.....	63.4	102	17	3.20	3.39	6.18
October.....	51.6	91	7	2.00	1.02	1.76
November.....	37.2	80	-15	.96	.18	.79
Fall.....	50.7	102	-15	6.16	4.59	8.73
Year.....	47.7	107	-41	27.72	17.17	37.50

AGRICULTURE.

The basic industry in Wayne County is agriculture. Originally the entire county was covered with a vigorous growth of prairie grasses. At first small tracts were broken and planted to corn and wheat, which, with milk, game, and pork, formed the chief foods. As there were neither local markets nor transportation facilities, the early development of agriculture was slow. The construction of the railroads gave the first marked impetus to the development of the farming industry.

The census reports the value per farm of all farm property, including land, buildings, implements, and domestic animals, at \$1,819 in 1880, \$6,034 in 1890, \$7,778 in 1900, and \$21,441 in 1910. The value of farm land per acre is reported in 1900 as \$27.47 and in 1910 as \$86.78. The average value of farm land at present is said to be not less than \$125 an acre. Between 1880 and 1910 the number of farms in the county increased from 142 to 1,408. The number reported in

1910 is practically the same as that in 1900, as by 1900 all the land had been taken up. The average size of farms shows considerable fluctuation, being greatest in 1890, when it is reported as 286 acres. It is given in 1910 as 195.2 acres. The percentage of improved land in farms in 1890 was about 61 per cent, in 1900 86 per cent, and in 1910 nearly 97 per cent. Corn, oats, wheat, and hay have been for many years the most important crops grown. The following table gives the acreage and yields of these four crops, according to the census of 1880, 1890, 1900, and 1910:

Acreage and production of principal crops.

Year.	Hay.		Oats.		Corn.		Wheat.	
	<i>Acres.</i>	<i>Tons.</i>	<i>Acres.</i>	<i>Bushels.</i>	<i>Acres.</i>	<i>Bushels.</i>	<i>Acres.</i>	<i>Bushels.</i>
1880.....	2,415	3,388	560	11,555	2,341	80,205	1,684	10,845
1890.....	18,330	30,260	10,008	249,402	54,156	2,211,490	11,624	185,255
1900.....	22,723	40,832	24,028	860,460	102,599	3,249,910	57,823	621,130
1910.....	58,175	109,614	51,852	1,229,121	106,297	4,284,535	7,846	115,287

Corn has been the most important crop throughout the history of the county. At first it was grown as a cash crop, but later much of it has been used in feeding cattle and hogs. For a number of years corn exceeded all other crops combined. The acreage of both corn and oats as well as of hay shows an uninterrupted and very rapid increase, corresponding in general to the rate of progress in breaking up the virgin prairie. The decline in the acreage in wheat between 1900 and 1910 was due largely to the unsatisfactory profits derived from spring wheat, which has always been the predominant variety. Even during the period of maximum acreage it was never entirely satisfactory, but was grown on account of its suitability in the rotation, its quick return as a cash crop, and the lack of hardy winter varieties.

The increase in the acreage of corn, oats, and hay has been accompanied by an increase in live-stock production. Probably one of the main reasons for the decrease in acreage of wheat is to be found in the greater returns obtained from the production of corn, oats, and hay in conjunction with stock raising. Alfalfa was first reported in the census of 1900, but since that time the acreage has greatly increased. This crop is having a marked effect on the agriculture of the county owing to its value as a nitrogenous feed and its importance in the upbuilding of the soil.

Small acreages of barley and rye were grown during the early stages of agricultural development, but these crops were never of more than secondary importance and were grown only for local con-

sumption. A total of 2,691 acres is reported in barley in 1910, but the acreage in this crop is now much smaller.

The first methods of farming were crude and wasteful, little attention being given to proper tillage, seed selection, crop rotation, and fertilization, with the result that crop yields were lower than might have been obtained under better methods. Later more attention has been given to handling the soil, and at the present time there is a general tendency among the farmers to improve the quality of plants and animals by careful selection and to increase the productive capacity of the soils by rotation, manuring, and the growing of legumes, such as alfalfa and clover.

As in other counties of eastern Nebraska, grain growing in conjunction with live-stock production, principally beef cattle and hogs, continues to be the chief type of farming. The table below gives the relative values of the farm products of the county. Although these figures are taken from the 1910 census and agriculture has advanced considerably since that time, the relative importance of the products remains about the same, except that alfalfa, classed with the hay and forage crops, is grown on a much greater acreage than it was nine years ago.

Value of agricultural products, by classes.

Product.	Value.	Product.	Value.
	<i>Dollars.</i>		<i>Dollars.</i>
Cereals.....	2,648,171	Live stock and products:	
Other grains and seeds.....	10,182	Animals sold and slaughtered.....	1,852,028
Hay and forage.....	372,142	Dairy products, excluding home use..	152,561
Fruits and nuts.....	27,593	Poultry and eggs.....	159,022
Vegetables.....	56,160	Wool, mohair, and goat hair.....	6,283
All other crops.....	3,583	Total value.....	5,287,725

Approximately 85 per cent of the total value of crops produced in the county is represented by cereals and about 12 per cent by hay crops. The total value of the corn, wheat, and oats produced in 1916, according to the State board of agriculture, was \$3,812,606.

Over 37 per cent of the total acreage of the county was devoted to corn in 1910, and, according to the State board of agriculture, the total area in this crop in 1916 was 104,947 acres, with an average yield of 39.5 bushels per acre, or a total of 4,145,406 bushels, valued at \$2,487,244. This ranks Wayne County as one of the leading corn counties of the State. Some of the corn is sold, but most of it is fed to cattle and hogs. A part of the crop is converted into ensilage and used to feed beef cattle. Most of the corn crop is husked in the field. The stalks after being pastured in the fall and winter are cut in the

spring and plowed under. White and yellow dent varieties are the most popular. An early strain of Reids Yellow Dent probably is the leading variety.

The cultural methods for corn are practically the same throughout the county. Much of the crop is listed, the single-row lister ordinarily being used, though some is check rowed. Besides being quickly planted, it is thought that listed corn withstands drought better and is easier to keep clean. However, the results obtained with this method over a period of years are not so good as those obtained under methods giving a more thoroughly prepared seed bed. On account of the heavy rainfall during the planting season, the listed corn is subject to severe washing. On rolling areas and on slopes entire rows of corn frequently are washed away. On bottom lands the plants frequently are covered with sediment or are drowned by water standing in the furrow.

Corn is grown on all the soils of the county, but does best on the Wabash silt loam, the Marshall silt loam, and the Waukesha silt loam. On many farms the crop is grown on the same land for five or six years in succession. Much better yields are obtained where it is grown in rotation with small grains and a legume—either red clover or alfalfa. In recent years increased attention has been given to improvement of seed corn. Over the county as a whole, however, little interest is taken in seed selection. Varieties of corn recommended by the Nebraska experiment station as being well adapted to this county are Reids Yellow Dent, Nebraska White Prize, and Iowa Silver Mine.

In acreage oats rank second to corn. In 1916 there were 62,017 acres in oats, yielding 47.1 bushels per acre, or a total of 2,921,001 bushels, valued at \$1,022,350. In 1914 and 1915 there were 53,929 acres and 56,330 acres, respectively. Kherson and Red Rustproof are the leading varieties. On several farms in the southeastern part of the county a late strain of the Kherson, called the Second Kherson, is grown. It is locally regarded as yielding better than the original strain, and is also preferred because it ripens late enough to permit harvesting after the second cutting of alfalfa. Very little effort is made to control smut in oats, although yields are sometimes lowered as much as one-sixth by this disease. The average yield fluctuates considerably on different farms. Maximum yields of 90 bushels per acre were obtained in the present season (1917), while on some farms yields were as low as 30 bushels. The variation is due to differences in the condition of the soil and in cultural methods. The estimated average yield for the county in 1917, based on reports by farmers, is 55 bushels per acre.

As a rule oats follow corn in the rotation. They are very seldom grown twice in succession on the same land. The crop usually is cut

with a binder and thrashed in the field from the shock. In some cases the crop is stacked. The straw is used for roughage on most farms, very little of it being sold. The grain is used mainly as feed for horses and other stock, but some is marketed. Seed frequently is imported from other sections.

The acreage devoted to wheat, which was an important crop in the county about 1900, is small. Winter wheat is displacing spring wheat, and the acreage is increasing. Of the winter varieties the Turkey Red is grown almost exclusively. Estimated yields of the Turkey Red wheat in 1917 were as high as 40 or 45 bushels per acre. The yield of winter wheat fluctuates less than that of spring wheat, though there is some danger of winter killing. This danger, however, is much less when the hardy Turkey Red variety is sown. Owing to the more satisfactory profits derived from winter wheat this crop promises to increase in importance.

As a rule, wheat follows corn or oats. Where the crop follows oats the ground is plowed in the late summer and thoroughly disked to prepare a compact seed bed. Where it follows corn the corn usually is cut for fodder and the ground disked thoroughly. Good yields are obtained in this way. Wheat is used as a nurse crop for clover and timothy. The crop usually is thrashed from the shock, although stacking is also practiced. Most of the grain is sold as soon as thrashed and some is stored and held for a higher price. Rust rarely causes severe damage to winter wheat, but is very destructive to spring wheat. Some damage is caused by smut, but no effort to control this disease is reported.

The acreage in hay has increased rapidly, keeping pace with the increase in the number of live stock in the county. The acreage in wild hay is still quite large on the poorly drained bottom lands, but only a few acres of upland remain in this crop. The yields of wild hay range from 1 to 2 tons per acre. The crop is stacked in the field and either baled for market or hauled to the feed lots as needed. Sioux City and Omaha are the principal markets for the hay. It sells for \$6 to \$11 a ton, depending on the quality and demand.

As the acreage in wild hay is being reduced that of alfalfa is increasing. The acreage in alfalfa is reported in 1916 as 18,816 acres, with a total production of 71,501 tons, valued at \$500,507. According to the census, the acreage in this crop in 1909 was 2,409 acres, showing a remarkable gain in eight years. In general, Wayne County is particularly well situated for the growing of alfalfa, the crop doing well on all the soils, except the Thurston fine sand and poorly drained areas of the Wabash silt loam and Scott silt loam. Three cuttings and occasionally four are obtained each season, giving a total yield of $3\frac{1}{2}$ to 5 tons per acre. The hay is of good quality

and nearly all of it is fed on the farms. While the production of stock reached important proportions before alfalfa was introduced, much larger numbers are maintained where the crop is included in the rotation. It not only has a high nutritive value and produces large yields, but is valuable in increasing the productive capacity of the soil for grain crops, particularly corn and oats. It is equal to red clover in this respect, although less well suited to short rotations.

Alfalfa usually is seeded in August or later after rains at the rate of 15 pounds per acre, and frequently with a nurse crop of wheat or oats. The stand usually is left for 7 to 10 years, or in some cases 12 years. The crop has not been grown long enough in the county to determine the length of time the stand can be left before deterioration sets in. Rarely a field of alfalfa is frozen out. A stand is easily obtained on fertile soil which has not been too severely cropped to grain. Liming is not necessary on any of the soils, although barnyard manure is beneficial in obtaining a stand on slightly impoverished land. The main consideration seems to be thorough seed-bed preparation. Disking is sometimes necessary to kill grass and weeds.

There has been considerable fluctuation in the production of clover, and it has been displaced recently by alfalfa to a great extent. The State board of agriculture reports 5,694 acres in clover in 1916. Before the introduction of alfalfa clover and timothy were largely substituted for wild hay. The soils, particularly the Marshall silt loam, the Knox silt loam, the Waukesha silt loam, and well-drained areas of the Wabash silt loam are well suited to clover where maintained in proper condition. Some failures to obtain a stand of clover are experienced in unusually dry seasons. Clover usually is seeded with a nurse crop in early March at the rate of 6 to 8 pounds per acre. If the rainfall is adequate when needed following the removal of the nurse crop clover does well and makes a luxuriant growth. It affords good fall pasture for hogs and cattle, and is cut for hay the following spring, with yields of 1 to 2 tons per acre. The second crop is sometimes used for seed, but more often it is used for fall pasture, and the following spring the land is planted to corn, which on clover sod gives heavy yields. In some cases the second crop of clover is plowed under and the land seeded to wheat. The growing of clover invariably results in increased yields of succeeding crops.

When mixed clover and timothy are grown, the first crop is almost pure clover, the second about an equal mixture of the two, and the third almost pure timothy. The census reports a production of 29,654 tons of mixed clover and timothy hay in 1909 on 17,039 acres. This hay is fed to stock on the farms, and it is held in very high esteem for work horses. Timothy alone was grown on 6,194 acres in 1916.

Alsike is grown in small fields on the bottom soils. It is well adapted to poorly drained areas, and good yields are obtained. Its value warrants an extension of its acreage on the imperfectly drained bottom soils and in areas of the Scott silt loam.

The acreage in barley is not important. A total of 620 acres is reported in 1916. Rye, millet, or Hungarian grass, and emmer and spelt are crops of minor importance. The State board of agriculture reports 17,850 acres in bluegrass in 1916. This is confined largely to the poorly drained bottom soils. Bluegrass and white clover have largely displaced the original wild grasses on the bottom soils.

Potatoes are reported on a total of 1,002 acres in 1916. This crop is grown mainly in small tracts for home consumption. Trucking receives little attention in Wayne County, but a few vegetables are grown on a commercial scale near Wakefield. Nearly every farm has a garden in which most of the common vegetables are grown for home use.

A considerable number of farms have small orchards of apples, cherries, and plums, which with proper care produce good fruit, but commercial orcharding is not practiced in the county. The census of 1910 reports about 22,000 apple trees, 10,000 plum trees, 6,000 cherry trees, and 6,500 grape vines. All the upland soils are well suited to fruit production. Similar soils are extensively used for this purpose in other areas in eastern Nebraska, Iowa, and Missouri. Cherries and plums apparently never fail on account of winter killing, while apples winter kill about once in five or six years. The principal varieties of apples are the Northwestern Greening, Ben Davis, Willow Twig, Winesap, Wealthy, Early Harvest, and Red June. Grapes do well on most of the soils of the area; like apples, they require special care in cultivation, pruning, and in spraying to control fungus diseases and insects. The good shipping facilities and the adaptation of the soils favor an extension of fruit growing.

The live-stock industry in Wayne County is very important. For 1916 the State board of agriculture reports 28,034 cattle, including milch cows, in the county, with a combined value of \$1,247,300.

The feeding of beef cattle in conjunction with hogs is the most highly specialized industry in the county. There are several large herds of pure-bred beef cattle in the county, and many pure-bred bulls have been introduced in recent years to improve the grade stock. The beef cattle, in general, are of high quality. The Hereford and Shorthorn lead, but Galloway and Angus breeds also are important. All the locally raised cattle are fattened for market, and, in addition, many farmers feed cattle purchased at the stockyards in Sioux City and Omaha. Probably there are more feeders than locally raised cattle, although there is a greater tendency at this time to raise and fatten

the cattle on the same farm, this method having received a strong impetus in recent years through the decline in number of the range cattle of western areas. The abundance of rich, nitrogenous feeds, such as alfalfa and clover, to balance the corn, and the good marketing facilities, are highly favorable to the beef-cattle industry as well as to dairying.

There are no farms in Wayne County on which dairying is the exclusive industry, but many farmers milk grade beef cows and sell cream at local stations. The number of pure-bred dairy cattle is very small, and it will be necessary to introduce pure-bred bulls of dairy breeds before an important dairy industry can be built up. Local opinion apparently favors the utilization of dual-purpose breeds or a combination of beef production and dairying. Many farmers have cream separators, and milk from 8 to 12 cows. Local conditions are favorable to the extension of the dairy industry.

According to the State board of agriculture there were 63,000 hogs in Wayne County in 1916, with a value of \$1,260,000, exceeding the value of cattle for that year. Nearly every farmer fattens 35 to 50 hogs a year, and large numbers are raised in connection with the feeding of beef cattle. On many farms from 100 to 150 hogs are fattened annually. Although most of the animals are not pure-bred, the quality of the stock in general is high. A few farmers practice crossbreeding, the result being a very inferior type of animal after the first generation. In general, however, the breeding of hogs is along constructive lines, and the crossing of different breeds is resorted to only for the purpose of obtaining certain market types. Hogs usually are marketed at 9 to 12 months of age. Poland-China and Duroc-Jersey are the most popular breeds. Practically all the hogs are raised and fattened on the same farms, but in a few cases stockers are shipped in to be fattened. Considerable losses are suffered in some cases through the prevalence of hog cholera. However, the outbreaks rarely result in as great losses as in former years, the disease being controlled to a large extent by vaccination and sanitation work, to which increased attention is being given. With the prevailing high prices of pork hog raising is very profitable.

There are only a few flocks of sheep in the county, a total of 722 sheep being reported in 1916. The favorable climatic conditions, and the abundance of rich nutritive feeds, would seem to warrant an extension of the sheep-raising industry. Large numbers could be fattened in the cornfields in the fall at a minimum expenditure of feed, and sold at a good profit.

Poultry is kept on practically all the farms and constitutes an important source of income. There is a good local demand for poultry products, and in general more attention is being given to

the industry, although there are no specialized poultry farms in the county. The Leghorn, Barred Rock, Rhode Island Red, Orpington, and Wyandotte are the most popular breeds of chickens.

Horses of high quality are raised on many farms, but seldom as the main product. The Percheron is the most popular breed, but other draft breeds also receive attention. Much improvement in horses has been made within the last 15 years, following the introduction of pure-bred stallions. Some mules are raised, but the local demand for mules is greater than the supply. There are more mules in the southwestern part than elsewhere in the county.

There is a marked general similarity in the classes and varieties of crops grown on the various soil types of the county. No part of the county has sufficient variation in elevation to influence the distribution of crops. The inadequately drained condition of the bottom soils has retarded their development to some extent, and large areas are still in pasture. However, some very extensive areas of bottom land are highly improved and used for the production of practically all the crops common to the county. Small areas are in alsike.

It is generally recognized that certain crops produce higher yields and that the products are of better quality on certain soils than on others. Corn, for instance, does better on the black silt loam soils of the Marshall, Waukesha, and Wabash series than on the Shelby fine sandy loam, but it is the most important crop on the Shelby soil, because no more profitable crop is known. Potatoes of the best quality are grown on the sandy soils, although potatoes are not grown commercially. Although the production of wheat has decreased, the soils are generally well adapted to this crop and the decline has been due to other factors than the unsuitability of the soils. Local conditions are such as to make it impossible to conform strictly to the growing of crops best adapted to a given soil.

Changing crops from year to year on any field is known to be a good practice, although in many cases systematic crop rotations are not practiced. The one ordinarily followed consists of corn for one or two years, or rarely three years, changing to oats, then to clover and timothy, and back to corn. This may be varied by growing a crop of alfalfa, or occasionally wheat and alfalfa. The most successful farmers do not grow corn more than two years in succession in the same field. Where corn is followed by oats the oats may be succeeded by wheat and the wheat followed by clover and timothy. On the bottom land corn is often grown for five or six years in succession on the same land, good yields being maintained. On some farms crops are not rotated until yields begin to decline. When clover fails to catch the value of the rotation is largely lost on account of the absence of a leguminous crop to build up the soil. Alfalfa can be made

to take the place of clover, but owing to the desirability of keeping the stand of alfalfa for five or six years or longer this crop does not fit so well in the rotation. There is a tendency to shorten the period of use of any one field for alfalfa. The experience of the alfalfa growers indicates that to obtain best results alfalfa should be changed once in five years. This method, supplemented with growing red clover in conjunction with stock feeding, results in increased yields of all the grain crops.

The importance of proper cultural methods is not fully appreciated. Wheat land is generally plowed in the fall just before seeding and the seed bed prepared with harrow and disk, little time being allowed between plowing and seeding time. Corn land usually is listed and sometimes double listed where the crop succeeds itself. It is considered the better practice in growing winter wheat to plow the ground in early summer, soon after the removal of the preceding crop, and to keep the soil well mulched until the time of seeding. Considerable barnyard manure is produced, but in most cases little care is taken to preserve it. On some farms the manure is piled outdoors without protection, and much of its fertilizing value is lost by leaching. The more progressive farmers haul the manure direct from the barns to the field, applying it mainly to corn and oats land. In the fertilization of the soil manure spreaders are coming into common use. Practically no commercial fertilizers are used.

The most troublesome weeds in Wayne County probably are the sunflower, Russian thistle, wild morning glory, and quack grass. Considerable damage is caused by these weeds. Some Canada thistle is found, but it has not spread to any considerable extent. Much greater efforts are made to eradicate this pest than the other weeds on account of its more destructive character.

The farm buildings throughout the county are generally well constructed, substantial, and kept in good repair. Quite a number of farms have gravity water systems to supply the house and other buildings. A few are equipped with electric lighting systems. The fields are generally well fenced, woven wire being extensively used. Modern farm machinery is in general use. Four-horse to six-horse gang plows are common, and power tractors are used on several farms. The work stock is of the heavy draft type, and is of good quality. Windmills are quite common, though on many farms gasoline engines are used for pumping water and running various kinds of light machinery. In general the appearance of the farmsteads indicates a prosperous agriculture.

The supply of farm labor usually is limited, and the members of the family do most of the farm work. Wages range from \$35 to \$50 a month with board and room. Where hired for short periods farm

laborers are paid \$1.50 to \$2 a day with board. Harvest hands are frequently paid \$2.50 to \$3.50 a day with board. Many farmers hire labor by the year to provide against a lack of labor at times when it is most needed. The 1910 census reports an expenditure of \$203,660, or \$264.84 per farm, for farm labor, a total of 769 farms, or about 55 per cent of the total number in the county reporting. According to the same authority 50.7 per cent of the farms are operated by owners, and practically all of the remainder by tenants. Both the cash and share systems of renting are followed. Under the prevailing system the owner receives two-fifths of the crop, the tenant furnishing implements, work stock, and labor. Where the owner furnishes the implements and work stock, the crops are shared equally. In some cases the tenant pays a cash rent for pasture land and grows the grain crops on shares. Cash rent ranges from \$4.50 to \$7 an acre, depending on the improvements and the productiveness of the soil. Rents are highest in the vicinity of Wayne. The highest priced land is near Wayne and in the eastern part of the county. Large farms on much of the Marshall silt loam, the Waukesha silt loam, and the better drained areas of Wabash silt loam are valued at \$175 an acre, and some at even a higher figure. Farms in the hilly areas in the southwestern part of the county, on the dark-colored Knox silt loam, range in value from \$125 to \$165 an acre, depending mainly on improvements. The sandy soils in the extreme southwestern part of the county are lowest in value, ranging from \$75 to \$125 an acre. The average value of land in Wayne County is estimated at about \$145 an acre.

SOILS.

The soils of Wayne County may be classed, on the basis of origin and method of formation, in three general groups: (1) Loessial soils, or soils derived by weathering from the loess or silt covering of the upland plain, (2) soils derived from unconsolidated glacial drift deposits, mainly sands of Pleistocene age, and (3) sedimentary soils composed of materials washed from surrounding upland. The loessial soils and the drift soils constitute the upland of the county, and the sedimentary soils the second bottoms or terraces, the first bottoms, and depressional areas within the terraces and upland.

In its unweathered condition the loess is an even-textured material composed largely of silt particles. It is characterized by a tendency to split into vertical planes producing perpendicular bluffs along water courses and roads and in other places subject to erosion. The color ranges from light brown to yellowish brown. The nearest approach to the typical loess in its original condition is in the areas of light-colored soil in the hilly belt southwest of Winside,

Since deposition most of the loess material has undergone decided changes due to climatic influences, the accumulation of organic matter, and various physical and chemical actions. The surface material over large areas to depths of 15 to 30 inches has changed to a black color owing to the decomposition of organic matter resulting from the rank growth of grasses and other small plants of the prairie. The dark-colored material is deeper in the smooth, level areas which favor the accumulation and retention of the decaying material. The maximum accumulation has taken place in depressional areas of the smooth table-land, and the minimum accumulation in eroded areas of steep surface relief where the run-off is great and leaching of the organic compounds rapid.

The mode of formation of the loess deposit in this region is not definitely known. The material is classed as loess on account of its similarity in physical characteristics, lithologic character, and stratigraphic position to the loess of the Missouri River. It is believed that soil material derived from glacial deposits in place may subsequently through the action of physical and chemical forces develop into material similar to this not only in physical characteristics but in the general character of its surface relief as well; in other words the loessial character is meaningless in determining the origin of the material. As an illustration of such development the extensive terrace soils or so-called valley loess of Dodge and Saunders Counties, Nebr., may be mentioned. The general evidence suggests the conclusion that this silty deposit in Wayne County and surrounding areas was brought to its present position by slowly moving water possibly during glacial times. It is classed as loess merely because it is very silty.

The loess formation gives rise to the extensively developed Marshall silt loam and the Knox silt loam. It covers about three-fourths of the total area of the county.

Immediately beneath the loess occurs a stratum of sand, the geological origin of which is not clearly understood, and below this lies the Kansan drift sheet. The drift outcrops prominently only along the Pierce County line in the southwestern part of the county. It is characterized by irregular masses of gravel, pebbles, and small stones mixed usually with considerable clay, silt, and sand. It evidently underlies all the upland. The sand layer is extensive in Thurston County, and the soil derived from it is classed with the Thurston series. This sand deposit probably is of the same origin as the Kansan drift sheet, but differs from it in the absence of gravel and small rocks and in the prominence of the sandy material.

The geologic strata directly underlying the Kansan drift sheet, as determined by well records and by outcrops in adjoining areas, con-

sist of alternating beds of limestone, sandstones, and shales of Pennsylvanian and Cretaceous ages. These formations are not exposed in Wayne County and are of no importance in soil formation. The soils derived from the sand formation and the Kansan drift, so far as it has contributed to the soil material, are classed with the Shelby and Thurston series.

As with the loess, the drift soils are of recent formation, geologically, and weathering processes have been in operation a comparatively short time. However, the lithologic character of the drift and the topographic conditions are especially favorable for the rapid leaching out of mineral constituents and erosion, so that there has been a less luxuriant growth of vegetation, and consequently less accumulation of decomposed organic matter than in case of much of the loess soils.

The terraces, or second-bottom soils, are important in Wayne County. They consist of reassorted material derived from the upland and deposited at former flood stages of the streams. The terraces consist of a first or low terrace and a second or high terrace. The soil material of the high terrace varies in thickness from 25 to 40 feet or more. It differs from the high terraces of Dodge County, Nebr., and other areas in that the underlying sand layer is either entirely absent or is at least not exposed at the surface. The first or low terrace lies 15 to 20 feet above the first bottom. The soils of the terraces are mapped as the Waukesha silt loam, the Waukesha loam, and the Scott silt loam.

The alluvial, or first-bottom soils, are derived from local upland material which has been washed from the land within the drainage basins of streams and redeposited in their flood plains. Excluding that along the streams of the Elkhorn River drainage system of the extreme western part of the county, the alluvial material is derived entirely from the upland loess. The soil is a black silt loam of strong productiveness. The alluvial material in the western part of the county is derived from the drift and its overlying sand formation. The soils are sandy and are very productive. In general the flood plains are broad, considering the small size of the streams. The first-bottom soils are classed with the Wabash and Cass series.

All the soils of Wayne County belong to the broad group of transported soils, or those composed of material which has been moved from the place where the original rock was broken down. But the material was deposited under varying conditions and at different ages, and the oxidation processes and drainage conditions since deposition have brought various changes in the character of the soils.

The soils in general have a relatively uniform agricultural value and are highly productive. The principal soils do not have the wide

range in physical characteristics and geologic derivation which characterizes many areas in the southern parts of the United States. The mineral and rock particles have been reduced by the processes of soil formation to a fine state, so that the soils are predominantly silty in texture. The sandy soils are of relatively small extent and are confined to the extreme western and the northeastern parts of the county.

Nine soil types, representing eight soil series, are mapped in Wayne County.

The Marshall series, as recognized by the Bureau of Soils, includes types with dark-brown to black surface soils and a lighter yellowish brown subsoil. It is characterized and distinguished from the lighter colored Knox series by the large quantity of organic matter in the surface soil and subsurface material. It is derived from loess. The topography is predominantly rolling and ranges to gently undulating, with some small flat areas. Drainage is good to excessive in places. The series is represented in Wayne County by only one type—the silt loam.

The soils of the Knox series typically are light brown, with a yellow to grayish-yellow subsoil. Like the Marshall soils these soils are derived from loess. The material has undergone less change in physical characteristics since deposition than that of the Marshall series, the most important change from the original loess being the darker color of the surface material, due to oxidation and accumulation of organic matter. Although this soil is subject to severe erosion and leaching it contains more lime than the Marshall soil. The Knox series is represented in this county by the silt loam type.

The Waukesha soils are dark brown to brownish black or black, and have a yellowish-brown to brown subsoil. They are derived from water-assorted loessial and glacial deposits. The topography is mainly flat to undulating. The Waukesha soils differ from the Marshall in origin and in having a more compact subsoil and lighter-colored surface soil. Two types, the Waukesha silt loam and the Waukesha loam, are mapped.

The surface soils of the Scott series typically are brown to black and the subsoil is drab to grayish. The Scott soils consist of lake-laid material eroded from the higher lying surrounding soils and deposited by sheet surface waters in temporary lakes or ponds occupying local undrained, sinklike depressions. The soils are poorly drained. The series is represented in Wayne County by a single type, the Scott silt loam.

One member of the Wabash series, the silt loam, is encountered in Wayne County. The soils of the Wabash series typically are black. They have a high organic-matter content. The subsoil is dark drab to drab. The material is alluvial in origin. It has been washed from the loessial and associated uplands.

The soils of the Thurston series typically are brown to dark brown. The subsoil is yellow to light brown, with sometimes a reddish tinge. These soils have a considerable range in texture, but coarse sand particles usually are present. The subsoil consists of a mass of loose sand of low water-holding capacity. The soils of this series are derived from sand, noncalcareous glacial deposits. The Thurston series is represented in this county by the fine sand type.

The Shelby series differs from the Thurston chiefly in having a heavy loam to silt loam subsoil. The soils are dark brown and the subsoil is brown or reddish brown. The material is derived from glacial drift. The fine sandy loam is the only member of the Shelby series mapped in Wayne County.

The Cass series is represented by the fine sandy loam type. The Cass soils typically are black in the surface section, and differ from the Wabash soils in having a brownish-gray, sandy subsoil. Drainage is good.

The following table gives the actual and relative extent of each soil type mapped:

Arcas of different soils.

Soil.	Acre.	Per cent.	Soil.	Acre.	Per cent.
Marshall silt loam.....	192,640	67.9	Scott silt loam.....	3,968	1.4
Flat phase.....	2,816		Cass fine sandy loam.....	1,856	0.6
Wabash silt loam.....	48,768	16.9	Thurston fine sand.....	960	0.3
Knox silt loam.....	4,992	6.6	Waukesha loam.....	256	0.1
Dark-colored phase.....	14,080		Total.....	288,000
Waukesha silt loam.....	12,608	4.4			
Shelby fine sandy loam.....	5,056	1.8			

MARSHALL SILT LOAM.

The Marshall silt loam consists of a black to dark-brown, friable heavy silt loam with an average depth of about 15 inches, underlain by a lighter brown, slightly heavier silt loam, changing below about 22 inches to a yellowish-brown, compact silty clay loam. This either continues throughout the 3-foot section without change or becomes heavier with depth until at about 30 inches the material consists of compact, yellowish-brown silty clay, faintly mottled in places with gray. At depths of 30 to 36 inches or more the subsoil frequently grades into a yellowish to brownish, friable silt loam. On gradual slopes to streams the color of the surface soil in places is black and the material prevailing deeper, often extending to 24 inches without change in color or texture. The deeper subsoil, below about 34 inches, is calcareous, the lime occurring in the form of concretions which are not over one-eighth inch in diameter.

This type has a number of variations from the typical. Frequently the subsoil between 30 and 36 inches from the surface is mottled yellow and light gray with reddish stains. Deep cuts show that the soil profile below 40 inches is generally a yellow to yellowish-gray, friable silt loam, containing reddish blotches resulting from the oxidation of concretionary material. This line of demarcation between the soil and subsoil usually is marked by a gradual change in both color and texture. The upper part of the subsoil generally has a granular structure. The depth of the surface soil depends largely on the topographic position. On flat divides and slopes it is 15 to 22 inches, while on sharp divides and shoulders of hills the yellowish-brown subsoil frequently is encountered at a depth of 10 to 12 inches. The type in these shallow areas represents an extreme variation toward the Knox silt loam which is not mapped separately where it occurs in very small areas.

Shallow, light-colored areas occur in the western part of the county, 6 miles north of Hoskins, in close association with the dark-colored phase of the Knox silt loam. This phase and the Marshall silt loam merge gradually, and the soil boundaries shown on the map are largely arbitrary. The separation is based entirely on difference in character of the subsoil, that of the phase being a light-yellowish to grayish-yellow friable silt loam similar to the subsoil of the Knox silt loam. Freshly plowed fields in these areas frequently have a spotted appearance, as the subsoil is brought to the surface in spots where erosion has thinned down the darker surface layer. In some cases these light-colored areas are noticeably heavier in texture than the typical soil.

In areas adjoining the Shelby fine sandy loam the loose covering over the sandy material is very thin, and erosion has resulted in a rather intricate mixing of the silt and sand particles, giving rise to areas of a loamy texture, but owing to the small extent of such areas it is not feasible to show them separately on the map. In this section small areas of loam and sandy loam, therefore, are included with the type.

The typical Marshall silt loam differs from the Knox silt loam in having a darker color, due to a higher organic-matter content and a smoother topography. The Knox silt loam in Wayne County is really an eroded phase of the Marshall silt loam, the original dark-colored surface material having been removed. The process is just the opposite of that giving rise to the Marshall silt loam from the original loess, the latter process representing an accumulation of decomposed organic matter resulting from the growth and decay of plants, while the formation of Knox silt loam areas through erosion involves the removal of the organic compounds in the surface material thereby exposing the original loess deposit.

In topography that part of the type west of Winside is strongly rolling to hilly, the southeastern part is slightly rolling in places to gently undulating or smooth, and the remainder of the type is rolling. Drainage of the strongly rolling to hilly areas is excessive. All the type has adequate surface and subsoil drainage. The topography affects the value of the soil to some extent, the highest priced land being in the smoother eastern areas. The slopes in the hilly section usually are steep and the divides narrow and crestlike. Over the rest of the type the divides are mainly broad and level and the slopes gradual.

The Marshall silt loam is the most extensive and important soil in Wayne County. It occupies about two-thirds of the total area, and all of it is in cultivation. It is regarded as one of the best upland corn soils in the Mississippi Basin. About one-half of the type in this county is in corn; the remainder is in oats, alfalfa, clover, timothy, and wheat. Good yields of corn are obtained in normal years, and in dry years the yields usually are greater than the average for the eastern part of the State, owing to the high water-retaining power of the soil. The average yield for the last six years is estimated by farmers to be as high as 45 bushels per acre. Yields of 60 to 65 bushels are common under good management. Where corn is planted more than two years in succession the yields decrease noticeably.

Oats rank second in acreage and yield about 40 bushels per acre on an average. During the present season (1917) some fields on the type yielded as high as 90 bushels per acre. Kherson and Texas Rustproof are the leading varieties of oats. The acreage in winter wheat is being increased. The average yield is between 25 and 30 bushels per acre, but many farms produce as much as 35 to 40 bushels per acre. The greatest uncertainty in wheat production results from winter killing. Formerly spring wheat was grown extensively on this soil, but the results were never satisfactory, and the acreage has greatly decreased since about 1895. Rust is very damaging to spring wheat but not to winter wheat. Of the winter wheats, Turkey Red is most extensively grown. Barley is grown to some extent on this type, but the acreage is small, other crops apparently being more profitable. It yields 25 to 30 bushels per acre. The acreage in clover, timothy, and alfalfa, although small in comparison with that in grain, is increasing. The tendency is to substitute alfalfa for a part of the clover, as the former is a more certain crop. Clover occasionally fails to catch. In favorable years clover yields from $1\frac{1}{2}$ to 2 tons of hay per acre. Clover and timothy mixed yield from $1\frac{1}{2}$ to $2\frac{1}{2}$ tons per acre. Alfalfa normally gives a total yield of $3\frac{1}{2}$ to $4\frac{1}{2}$ tons per acre a season. Practically all the hay produced is fed to live stock.

Corn on this soil is generally listed, but some is checked. Where oats or wheat follows corn the land is disked. Plowing for wheat usually is done in the late summer just before seeding. The soil is easily handled and can be plowed under a wide range of moisture conditions. It is very drought resistant where properly tilled. Little or no commercial fertilizer is used, but manure is applied by the more progressive farmers. This soil responds readily to manuring. It is apparently high in lime, and where alfalfa or clover has a place in the rotation its productiveness is easily maintained without the extensive use of commercial fertilizers.

Beef cattle and hogs are raised extensively on this soil in conjunction with grain growing. The fattening of live stock is the most highly specialized industry. All the cattle raised locally are fattened for market, and in addition many animals are shipped in from Omaha to be fattened. The hogs are mainly raised and fattened on the same farms, although a few are bought as feeders. The cattle usually are sold when 2 or 3 years old, although there is a growing tendency to finish them as yearlings or "baby beeves." Both methods are considered profitable. Hogs usually are marketed under 1 year of age.

Sweet clover is being introduced on some farms as a pasture crop. It is regarded as highly efficient in improving impoverished lands. It is seeded with oats as a rule and pastured after the grain is removed. The usual rotation on this soil consists of corn one year or two years, followed by oats or wheat one year, and then clover and timothy. Alfalfa following oats or wheat usually is allowed to stand seven or eight years or more before returning the land to corn. Many farmers grow the same crop continuously for several years. The most improved modern machinery is used on the farms of this soil. Where the slopes are steep the operation of heavy farm implements is rather difficult. Four horses are used for most of the work. The work horses are of heavy draft type. Scarcely any land of this type remains in the original prairie condition. There is practically no waste land, even in the strongly rolling areas.

Although most of the Marshall silt loam is still in a high state of fertility, the productiveness of the soil on many farms is gradually decreasing, notably so on tenant farms. A good illustration of the disastrous affects of excessive cropping to grains is found about 8 miles southwest of Wayne, on a few estates which are held in trust and have been rented for years without any supervision in regard to cropping systems. The yield of all the staple crops on this land is lower by 60 per cent than in surrounding areas.

Improved farm land on this type has a value of \$165 to \$195 an acre, the difference in price being due mainly to the character of farm improvements and location.

In general, not enough leguminous crops are grown to maintain the supply of organic matter in the soil. In the absence of an adequate supply of stable manure the productiveness of the soil can not be maintained unless a leguminous crop, such as alfalfa or clover, is grown at least once in every four years. The soil is well adapted to both of these crops, and they can be made the basis of the rotation, the hay to be fed to live stock and the manure returned to the land, and an occasional crop plowed under. Another method of adding organic matter, practiced in other States, notably Illinois, with success is to sow sweet clover in oats or wheat to be plowed under in the fall or following spring. In this way it is possible to have two leguminous crops to plow under in each rotation and yet grow three grain crops in the four-year period. Where it is difficult to grow red clover, as on some of the run-down land an application of bone meal is beneficial. Where live stock is not kept in considerable numbers clover may be plowed under as green manure the year following the season of seeding. It is a good practice to plow the entire crop under when the soil is very deficient in nitrogen. The yield of winter wheat is materially increased by early plowing. The oat or clover sod is best plowed as soon as possible after harvest and a firm seed bed prepared. Experience on many farms has shown the superiority of thorough seed-bed preparation for corn over the prevailing method of listing the crop.

The control of erosion is one of the most important problems in the management of this soil. The losses from erosion have not been appreciated, because with the addition of decaying organic matter and exposure to the air the subsurface soil to great depths produces as good crops as the present surface soil. With the gradual depletion of organic matter and the continued washing away of the surface material, the soil is ultimately left in an unproductive condition, and the land gullied and rendered uncultivable. Erosion is already serious in many areas of this soil. During the present season entire rows of corn have been washed out, and in listed fields the soil in places was washed away as deeply as plowed. Erosion is most active during the spring months, April and May. The tendency to wash may be counteracted by having the rows, especially in listed corn, follow contour lines, the soil being deeply cultivated to facilitate the absorption of water. Keeping the surface covered with a crop as much of the year as possible is also beneficial. After ditches have been formed, the prevention of erosion is more difficult. A method practiced with considerable success in other areas consists of building a dam of earth or stone across the ditch in the lower part of the field to check the run-off. A sewer pipe passes through the dam and connects with an upright pipe on the upper side. The sediment held by the dam gradu-

ally fills the ditch. A tile drain usually disposes of the water left standing below the upright pipe.

Marshall silt loam, flat phase.—The Marshall silt loam includes several areas of soil having a flat topography, which are shown on the accompanying soil map as a flat phase of the type. The soil of this phase is a black or dark-brown silt loam, underlain at about 20 inches by a yellowish-brown, compact silty clay loam to silty clay. Occasionally the lower part of the 3-foot section shows faint mottlings of gray. The subsoil is compact and hard when dry, but friable when moist. The section between 20 and 25 inches is decidedly granular in structure, owing to the concentration of clay particles, which is more marked than in the typical Marshall silt loam.

The Marshall silt loam, flat phase, represents remnants of the original loess plain, which have not lost any of their surface features through erosion. It differs from the typical in having a more compact subsoil and a flat, plainlike topography. On account of the level surface there has been a slower run-off of rainfall, a more abundant vegetation, and, consequently, a greater accumulation of organic matter. The lower subsoil or substratum is usually calcareous, the lime being present in the form of concretions. Both surface drainage and internal drainage are adequate, although streams have not cut back into the area.

This phase occurs in small, isolated areas in the southeastern part of the county. Few of the areas are more than 100 acres in extent. The soil is derived from the loess of the loess plain through weathering processes, the accumulation of decayed vegetation, and chemical changes.

All the flat phase is under cultivation. Owing to the level surface there is no waste land, and improved machinery can be used to great advantage in the cultivation and harvesting of crops. The type of farming is similar to that on the typical Marshall silt loam. Corn, oats, alfalfa, clover, and timothy are most extensively grown. Corn yields about 45 bushels on an average under the ordinary methods of cultivation. In exceptional cases, where the land is heavily manured or where particularly careful cultivation is practiced, higher yields, ranging up to 65 bushels, are obtained. Oats do well; average yields of 40 to 50 bushels per acre, and 70 bushels per acre in exceptional cases are obtained. The yields of timothy and clover hay are probably $1\frac{1}{2}$ to 2 tons per acre, although it is rather difficult to obtain accurate estimates. There are a few fields of spring wheat, but yields are lower than those of winter wheat. Spring wheat rarely yields more than 20 bushels per acre, while winter wheat averages from 25 to 30 bushels per acre. Alfalfa does well on the phase and is receiving increasing attention. In general the yields of all crops are slightly higher than on the typical Marshall silt loam.

Land values range from \$175 to \$190 an acre, depending mainly on the character of improvements.

The phase in general needs only good, constructive farming, including the growing of leguminous crops as in the case of the typical Marshall silt loam to keep it permanently productive.

KNOX SILT LOAM.

To a prevailing depth of 8 to 10 inches the Knox silt loam is a brown to light-brown silt loam. This grades into a yellow, heavy silt, which extends to a depth of about 20 inches. The lower subsoil is a yellow, friable silt loam to 36 inches or more, much lighter in texture than the subsurface layer. Reddish-yellow iron stains and lime concretions are common in the subsoil. The surface soil varies in color with difference in topographic position. On sharp divides and steep slopes the lighter colored material is exposed, while on broader divides and moderate slopes the soil is darker in color, resembling the dark-colored phase of the type. The boundary between the Knox silt loam and the Marshall silt loam is indefinite, as the two soils grade imperceptibly into each other. In general the Knox silt loam occupies the tops of ridges within the Marshall silt loam areas. In these situations it virtually represents the subsoil of the Marshall silt loam, the dark-colored surface material having been washed away. The soil represents the original loess which is only slightly modified by weathering forces. When exposed to the air under conditions of accumulating decayed vegetable matter this soil approaches the Marshall silt loam in physical characteristics. Such a process may be termed a constructive or building-up process, whereas the formation of Knox silt loam areas through erosion of the dark-colored surface soil is destructive.

The largest areas of the Knox silt loam occur in the western part of the county, but small bodies are encountered throughout areas of the Marshall silt loam. Only a few areas are found in the southeastern part of the county. Along the areas of sandy soils in the southwestern part of the county there has been more or less mixing of the sand particles within areas of the Knox silt loam, giving rise to areas of loamy texture, but these are too small and irregular in occurrence to be separated satisfactorily.

In places the subsoil below about 30 inches is strongly mottled with gray. Usually the surface soil of these areas is lighter in color and heavier in texture than the remainder of the type. In other places the surface soil is heavy in texture, consisting of a silty clay loam to silty clay. The heavy texture is due to the concentration of clay particles in the subsurface layer, erosion having exposed this material. This heavy soil is most prominent within areas of the Marshall silt

loam and is easily detected by the greater difficulty of cultivation. The development is popularly spoken of as clay or as "hardpan," although it is not a true hardpan. The unfavorable structural condition can largely be remedied by manuring or other methods of maintaining the organic matter content.

The Knox silt loam prevailingly occupies narrow divides and points between drainage ways. It is thoroughly drained and is very retentive of moisture, considering its low organic-matter content. This is due to the absorption of water. The type is dissected by short streams and is subject to severe erosion during periods of heavy rainfall, but since the subsoil material is productive after aeration and incorporation of organic matter the effect of erosion has not been keenly felt.

The native vegetation of the Knox silt loam consisted of prairie grasses. All the type is now under cultivation. The staple crops common to the county are grown and good yields are obtained. The soil is particularly well suited to alfalfa on account of its thorough drainage and high lime content. Yields of 3 to 4½ tons per season per acre are obtained. Corn yields from 30 to 40 bushels per acre. The average yield of oats is about 40 bushels per acre, and timothy and clover about 1½ tons. Crops are rarely injured by drought.

Most of this type has been used for growing corn and oats since the early history of the county, and it is only during the last 10 years that much of it has been seeded to alfalfa and clover. Potatoes, where the land is manured, do better than on the Marshall silt loam. The type usually receives most of the manure produced on the farm, although the supply is not sufficient as a rule for best results. Commercial fertilizers are not used, and green manuring is not practiced.

Owing to its irregular distribution in small areas no definite value can be assigned to this soil. It is usually held in conjunction with the Marshall silt loam, and slightly reduces the value of farms owing to the steepness of its slopes and the generally unfavorable topography.

The Knox silt loam is naturally low in organic matter, and owing to this deficiency and to its rougher topography is not so well suited to grain growing as the Marshall silt loam. Its productiveness has decreased under the present methods of farming. The use of much larger acreage for leguminous crops, to which the soil is well adapted, would be beneficial. Erosion is serious on this soil; its damaging effects may be lessened by growing winter cover crops. With an adequate supply of organic matter this soil is as productive as the Marshall silt loam.

In other counties of Nebraska and in surrounding States this soil is extensively used for the production of small fruits, fruits, and

vegetables. In Douglas County, Nebr., and Buchanan County, Mo., the growing of small fruits is becoming an important industry. In Wayne County the climate apparently limits the production of certain kinds of fruit, but no doubt the fruit-growing industry in general could be profitably extended on the Knox and Marshall soils. Potatoes also are profitably produced on this type in other areas.

Knox silt loam, dark-colored phase.—This phase consists of 6 to 8 inches of a dark-brown to almost black silt loam, underlain by a light-brown silt loam to silty clay loam. At about 15 inches the subsurface material grades into a yellowish-brown or yellow, smooth silt loam which either continues without change throughout the remainder of the 3-foot section or shows slight mottlings of gray in the lower part. Minor variations in color of the surface soil occur with changing topography, the dark-colored material being deeper on broad divides and gentle slopes. At the bases of some of the slopes there are coluvial and taluslike accumulations where the soil is black to a depth of 20 inches. On steep ridges there is frequently little change in the color or texture of the entire 3-foot section, the material being a yellowish-brown silt loam similar in physical characteristics to the typical Knox silt loam, but included with the phase on account of its irregular occurrence in small areas.

The Knox silt loam, dark-colored phase, is a gradation between the Knox silt loam on the one hand and the Marshall silt loam on the other. The surface material approaches the Marshall silt loam in physical properties, and the subsoil is typical of the Knox silt loam. However, the surface material is not so dark as that of the Marshall soil, and is very much shallower, the dark color rarely extending below 10 inches. Both the soil and subsoil are calcareous.

This phase is most prominently developed southwest of Winside, and is confined largely to the hilly belt of that section. Small areas occur throughout the southwestern part of the county. Most of the areas of typical Knox silt loam to the west of Carrol are very similar to the phase in physical properties, but on account of the extensive occurrence of the Marshall silt loam in this section and the less marked hilly topography these areas are included in the typical.

The topography of the phase is hilly to strongly rolling. Both surface and internal drainage are thorough. On account of the steep topography erosion is active.

The phase comprises rather extensive areas of good agricultural land in the southwestern part of the county. All of it is in cultivation, corn, oats, alfalfa, clover, and timothy being extensively grown. Yields compare favorably with those obtained on the typical Knox silt loam, and in general are somewhat lower than those on the Marshall silt loam. The type of farming is the same as that on the

typical Knox and Marshall soils, except that more stock is pastured on account of the steepness of the slopes being unfavorable to tillage. The use of heavy farm machinery is difficult but not impossible.

This soil is derived from the loess deposit. Originally all of it was in prairie grasses. Aside from the difference in color of the surface material the phase represents a topographic condition rather than a distinct soil, most of it being very similar to the typical Knox silt loam except in the darker color of the surface layer. The difference in color from the Marshall silt loam is due to different processes of weathering resulting from topographic position.

Beef cattle and hogs constitute the principal live stock. Many of the farmers milk grade beef cows and sell the cream, and this practice is very profitable. Owing to the hilly topography and the abundance of rich leguminous crops, such as alfalfa and clover to balance the corn, the phase seems well suited to dairying. It also comprises many good orchard sites and seems well adapted to fruit production.

Land of this phase can be bought for \$100 to \$125 an acre, depending mainly on the improvements. It has a lower agricultural value than the Marshall silt loam. The percentage of organic matter is lower, and, being porous, the soil is not so retentive of moisture. Most of the higher hills are wind swept in the winter and snows do not accumulate, so that winter wheat and similar crops are more likely to freeze out than on adjoining land. The liberal use of manure is needed more than on the other silt loam soils to maintain its productiveness, a good tilth, and profitable yields.

WAUKESHA LOAM.

To a prevailing depth of 15 inches the Waukesha loam consists of a dark-brown loam and this grades into a brown loam. Below about 20 inches the subsoil is a light-brown sandy loam to sandy clay loam. This continues without important changes throughout the remainder of the 3-foot section. The type is variable in texture. There are places where the surface 15 inches approaches a fine sandy loam and the subsoil is composed of alternate strata of sandy loam and loam. In other places the entire 3-foot section shows little variation, being a brown loam throughout.

The Waukesha loam is not extensive in Wayne County. It is developed in the extreme northeastern part in Logan Creek Valley. It occupies a terrace position about 10 to 15 feet above the first bottom. The surface is smooth to gently sloping toward the valley. Drainage is good. The soil is fairly drought resistant, but differs considerably in this respect according to the percentage of sand in

the subsoil. In small areas where the subsoil is predominantly sandy crops may suffer during drought.

All of the type is in cultivation. Originally it supported a thick growth of wild prairie grasses. Corn, oats, and alfalfa are the most important crops. Corn yields 45 to 50 bushels per acre. The crop is usually listed. Oats yield from 40 to 45 bushels per acre on an average, but yields of 70 bushels are obtained in especially favorable seasons. Oats have a tendency to lodge on this soil. Alfalfa yields from $3\frac{1}{2}$ to 5 tons per acre per season. Owing to the sandy composition of the soil it is easily handled and can be cultivated under a very wide range of moisture conditions. It is seldom too wet for cultural operations. Modern machinery is used successfully on this soil. Fertilizers are not used. Some beef cattle and hogs are kept, the feed being grown on adjoining soils.

The Waukesha loam is held mainly in conjunction with the Wabash silt loam, and no definite value could be assigned to it.

The incorporation of organic matter and deeper plowing are needed to keep this soil in a permanently productive condition.

One small area of a fine sandy loam is included with the Waukesha loam, as mapped. It occurs in the northeastern corner of the county, and comprises about 30 acres. Typically the surface 12 inches consists of a dark-brown to brown fine sandy loam containing a high percentage of coarse sand. To about 20 inches the subsurface material is a loam to heavy loam of brown color, and this passes into light-brown sandy clay. The surface texture varies from fine sandy loam to loam. Where the texture is heavy the dark color of the soil extends to depths of 15 or 18 inches. The soil is free from gravel.

This soil occupies the lower slopes adjacent to Logan Creek Valley. It is more extensively developed in Thurston County, on the east. It represents alluvium brought down by the waters of Logan Creek. The surface is only a few feet above the typical Waukesha loam. Drainage is good. The soil is well supplied with organic matter, and good yields of corn and oats are obtained. Corn yields 40 to 45 bushels and oats 40 to 50 bushels per acre. The heavy subsoil is retentive of moisture, and the type is fairly drought resistant.

All of this soil is in cultivation. Its porous character makes it early in the spring. It is ideally suited for the production of such crops as melons, muskmelons, and potatoes, but these are not grown, except for home consumption.

WAUKESHA SILT LOAM.

The Waukesha silt loam consists of a dark-brown to black silt loam about 15 inches deep, gradually changing to a light-brown to yellowish-brown, heavy silt loam, which extends to a depth of 20 inches,

Below this a yellow to brownish-yellow, compact silty clay loam is encountered. This extends to a depth of about 30 inches, below which the subsoil again approximates a heavy silt loam in texture, and is much more friable and loose than the compact layer above. This lower subsoil stratum is yellow, with occasional mottlings of gray. There is usually no change in color or texture of the subsoil material to depths of 10 or 12 feet. The heavy, compact subsoil layer is the result of the action of percolating water carrying down the finer clay particles from the surface material. Lime concretions are common in the lower subsoil of the Waukesha silt loam, but the interstitial material does not effervesce with acid. The soil profile resembles that of the Marshall silt loam. The soil has a structure similar to that of the loess, but it is somewhat heavier and the sub-surface stratum is more compact. The deeper cuts along slopes show a profile similar to that of the loess underlying the upland.

The Waukesha silt loam occurs in discontinuous terraces throughout the county. The largest single area lies along Logan Creek near the northeastern corner of the county. Other important areas occur near Wayne and Carrol. The topography in general is flat to gently sloping, including small depressions or basinlike areas occupied by the Scott silt loam. Drainage is good. The subsoil is retentive of moisture and crops do not suffer except from unusually severe droughts.

The Waukesha silt loam is an important soil type, comprising some of the most valuable land in the county. All of it is in cultivation or pasture. Originally it supported a heavy growth of prairie grass.

The most important crops produced on this soil are corn, oats, alfalfa, clover, and timothy. The acreage in corn is about equal to or somewhat greater than that devoted to oats, and the acreage in hay crops is decidedly less. Probably 1 acre in 30 is devoted to hay. Most of the corn is fed to beef cattle and hogs. The feeding of live stock is the most highly specialized industry. Nearly all the hay is fed to stock, but some is sold. Some wheat is grown. The acreage is not large but is increasing. The wheat is sold.

On nearly all farms some cows are milked, the surplus cream being sold to a local creamery. Few cows of the dairy breeds are kept. Most of the animals are good grades of the beef breeds, principally Shorthorn and Hereford. The Shorthorn is mainly used where milk is produced commercially. Nearly all the farmers fatten a few steers each year. Probably more hogs than cattle are fattened. The hogs raised are of very good quality and include some pure-bred animals. The Poland-China seems to be the favorite breed.

Corn yields from 40 to 60 bushels per acre, oats from 40 to 65 bushels, and wheat from 20 to 30 bushels. Clover and timothy yield

from $1\frac{1}{4}$ to 2 tons of hay per acre. Alfalfa yields from 3 to 5 tons per acre per season, three cuttings usually being made. This crop is gradually taking the place of clover and timothy. Wheat yields 20 to 35 bushels per acre.

The soil of the Waukesha silt loam is easily tilled, and does not clod or bake badly on drying. It is naturally retentive of moisture and resistant to drought. The land responds readily to improvement and fertilization, and with good methods of cultivation, such as are employed by the best farmers, its productiveness is easily maintained. The prevailing rotation on the soil is corn two years, oats or wheat one year, followed by timothy and clover, after which corn is again planted. This is occasionally varied by growing a crop of alfalfa. Alfalfa is usually grown seven or eight years before the land is returned to corn. Corn usually is listed when it succeeds itself, and generally checked on sod or stubble land.

Four-horse and six-horse teams are in general use on this type. There is a tendency, as on all the important soil types, to employ the most efficient machinery and increased horsepower in order to economize on manual labor. Farm tractors are used to an increasing extent. Practically no commercial fertilizer is used, but the use of barnyard manure is general. It is usually applied to corn land. One application of manure results in increased yields for several seasons. In general, the best farms are those on which live-stock feeding is carried on. The growing of clover is not so successful as formerly, there being considerable difficulty in obtaining a stand. On this account alfalfa is being substituted where a leguminous crop is desired. The general tendency is to grow less corn and more alfalfa, and to keep more live stock; but at the present time not more than 1 acre in 30 is devoted to the production of leguminous crops.

The Waukesha silt loam sells for \$135 to \$180 an acre, depending chiefly on its location with respect to towns and transportation lines.

This type, although very responsive to improvement and fertilization, varies widely in productiveness, and is gradually deteriorating under the prevailing system of extensive grain growing. The maintenance of permanent productiveness requires a more liberal use of manures. Growing clover or alfalfa on about one-fourth of the farm land each year is a good practice. The soil is well adapted to both these crops on account of its favorable structure, good drainage, and high lime content. Where the organic matter has become seriously depleted so as to make the growing of clover difficult, applications of a phosphatic fertilizer, such as bone meal, are needed. Both alfalfa and clover are effective green manures where the nitrogen content of the soil is low. Another method of improving the soil is to sow sweet clover in oats or wheat, to be plowed under in the fall

after the grain is harvested. In this way two leguminous crops can be grown in the rotation.

A high-terrace variation of the Waukesha silt loam occurs in the eastern part of the county along the first bottoms of Logan Creek on the high terraces lying about 30 to 35 feet above the first bottoms. The soil is very similar to the Waukesha silt loam of the first, or low terrace, being a dark-brown to black silt loam to a depth of about 15 inches, below which a brown to light-brown heavy silt loam is encountered. Below about 20 inches the subsoil is a yellow to brownish-yellow, friable silt loam.

This variation occurs in three areas. The largest is south of Coon Creek, on the Thurston County line; one lies north of Coon Creek, touching the Dixon County line west of Wakefield; and the third is south of Logan Creek, to the southeast of Wayne. The area near Wayne suggests an old valley of Logan Creek which in former ages probably followed the present course of Coon Creek. This area has such a very gentle slope from the center toward Logan Creek on the north and toward Coon Creek on the south as to make it difficult to determine the direction of the small streams which flow through it.

The soil on the high terraces is well drained. The surface is generally flat. It has a well-defined topography and is easily recognized, being bordered on the side toward the stream by rather sharp and more or less eroded escarpments, with generally a fairly well-defined escarpment between it and the upland.

Practically the same crops are grown, with the same relative importance, cultural methods, and yields as on the typical Waukesha silt loam. Since there are no included areas of the Scott silt loam, these high-terrace areas have a slightly higher value than the typical. The land is valued at \$165 to \$190 an acre, depending on its location with respect to towns and improvements.

SCOTT SILT LOAM.

The Scott silt loam consists of a black, floury silt loam usually about 15 inches deep, underlain by a very compact drabbish-gray to gray silt loam, which usually rests at about 30 inches on a heavy, impervious, drab clay mottled with gray and brown. When dry the surface soil has a dark-grayish color. In some areas the black silt loam surface layer continues without change to a depth of 25 inches, the subsoil below this being a grayish silt loam to silty clay. When dry the subsoil usually is ashen gray in color. In places the heavy subsoil is not encountered until a depth of 40 inches is reached. The lower subsoil usually is calcareous and contains iron concretions.

The Scott silt loam occurs in small, irregularly distributed areas. The most prominent bodies are in the northeastern part of the county,

between Coon and Logan Creeks, near the county line, within areas of the Waukesha silt loam. Inconspicuous areas within bodies of the Marshall silt loam are encountered in sec. 7, T. 26 N., R. 5 E.; secs. 15 and 18, T. 25 N., R. 5 E.; and secs. 1, 2, 10, and 34, T. 25 N., R. 3 E. Only a few areas exceed 25 acres in extent, and most areas comprise less than 15 acres.

This soil is mainly of lacustrine origin, consisting of material washed from the higher lying Waukesha silt loam and Marshall silt loam and deposited in shallow water collecting in depressions. The surface is flat or slopes very gradually toward the center of the area. Drainage is poor. The depressions of this soil in sec. 9, T. 26 N., R. 5 E., receive the run-off from large areas of surrounding land and are frequently inundated for days following rains. In wet years crops are damaged by standing water. No outlet ditches have been constructed, and the cost of construction in most of the areas is prohibitive under present conditions.

All the areas of this soil except a few within bodies of the Waukesha silt loam are in cultivation, the remainder being pasture land. Originally there was a heavy growth of the common wild prairie grasses. Corn, oats, clover, and timothy are the main crops. The crops are fed to beef cattle and hogs on areas of the adjoining soils. Corn yields from 20 to 65 bushels per acre, oats from 20 to 60 bushels, and hay from one-half ton to 2 tons, depending on the rainfall, the best yields being obtained in seasons of low rainfall. In wet years crops frequently fail, and there is always considerable difficulty in obtaining a stand of corn. The type occurs in small areas surrounded by other soils which are in condition for planting when the Scott silt loam is still much too wet.

The land is held in conjunction with areas of the Waukesha and Marshall silt loams and generally depreciates the value of those types.

Better drainage is the most important need of the Scott silt loam. Its irregular distribution in small, isolated areas throughout the better drained soils makes it impossible to follow special cultural methods or to grow special crops. The soil is rather cold, and planting is delayed considerably until the soil becomes sufficiently warm and dry.

This soil is well supplied with organic matter and lime, but owing to the difficulty of growing clover or alfalfa the maintenance of the organic-matter content is difficult. Alsike, according to extensive experiments in other areas, does much better and should take the place of red clover in the rotation. A few of the areas can be drained by ditching, and the soil could then be handled in much the same manner as the surrounding types.

THURSTON FINE SAND.

This is a brown to grayish-brown fine sand to a depth of about 6 inches, below which it grades into a yellowish-gray or yellowish-brown fine sand to sand. The subsoil below about 20 inches is a yellowish-gray to yellowish-brown loamy sand of open, porous structure. The surface layer contains a fairly high percentage of organic matter, but this is quickly exhausted under cultivation.

The Thurston fine sand is widely variable in both texture and color. In texture it ranges from a fine sand through loamy fine sand to fine sandy loam and in color from light brown to gray. Where the open, porous sand of the subsoil is exposed by erosion the type is lighter in color and is subject to wind drifting. Such a development occurs in the area south of Hoskins in sec. 34, T. 25 N., R 1 E. Areas of a loamy texture or of fine sandy loam are darker in the surface material, and the sand stratum usually is not encountered above 25 inches. Most of the type occurs within areas of the Shelby fine sandy loam having a terracelike position and lying between the higher areas of Shelby fine sandy loam and the first-bottom soils. It would probably be classed as terrace material were it not for the outcrop of the Kansan drift at lower elevations.

The largest area of this type occurs along the Pierce County line 3 miles west of Hoskins. Smaller areas are mapped south and north of the main body, the largest of these being the area in secs. 6 and 7, T. 25 N., R. 1 E. The type occupies the lower part of the slope from the loessial upland to the first bottoms. It is lower than the adjacent Shelby fine sandy loam. Outcrops of the Kansan drift occur along the Pierce County line. These contain considerable gravel and small boulders, but most of the type is free from such material. The type is derived in large part from the sand deposits overlying the Kansan drift, being similar in this respect to the Shelby fine sandy loam.

The topography varies from flat to gently sloping. The type has good surface drainage and excessive underdrainage. It is leachy and unretentive of moisture. About 50 per cent of the type is in cultivation, but yields are low. Corn is the crop most extensively grown and yields from 15 to 20 bushels per acre. Oats rank next in acreage and yield from 25 to 30 bushels per acre, depending on the season. Millet is considered a good crop on account of its ability to withstand dry periods. It yields from three-fourths to 1 ton per acre. Alfalfa and clover do not do well on this type. When manured it produces a good quality of potatoes, but this crop is grown only for home use. That part which is not in cultivation is in pasture land. The soil supports a good growth of wild grasses and grazing apparently is the best use to which much of the land can

be put on account of the droughty condition and the lack of plant food.

The Thurston fine sand is of little economic importance on account of its small extent. It is irregular in distribution and is held largely in conjunction with more valuable types. Where farmed it requires heavy manuring. Sweet clover could be made the basis of the rotation on this soil. It is better adapted to sweet clover than to either red clover or alfalfa.

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

Mechanical analyses of Thurston fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
373907.....	Soil.....	0.5	4.1	8.6	68.9	7.5	4.8	6.0
373908.....	Subsoil.....	.2	5.1	12.4	64.5	7.8	4.6	5.4

SHELBY FINE SANDY LOAM.

The Shelby fine sandy loam to a depth of 12 to 15 inches consists of a brown to dark-brown fine sandy loam. This grades quickly into a yellowish-brown sandy loam to loam, which in turn is underlain by heavier loam to silt loam material.

The type includes some textural variations. Probably the most frequent variation is in the subsoil, in which layers of sand or fine sand alternate with heavier loamy material. In places the entire subsoil below about 30 inches consists of a grayish fine sand. Where such areas are of sufficient extent they are included with the Thurston fine sand. Throughout the main body of the type there are small areas in which the texture is a loam to a depth of 15 inches, grading into brownish to reddish-brown sandy clay loam. Along areas of the Knox and Marshall types the soil approaches a silt loam, owing to the mixing of the silt particles of the overlying loess by erosion. Sand pockets frequently occur.

One and one-half miles west of Hoskins the type occupies a terrace-like position, being about 25 feet lower than the highest area south of Hoskins and about 15 to 20 feet above the first bottom. However, owing to the fact that the typical Kansan drift material outcrops at still lower levels, and to the inextensive area of such terrace-like material, it is classed as Shelby. Furthermore, the soil shows no variation from the typical except in topography, the terracelike area being smooth to gently sloping.

The Shelby fine sandy loam is derived in large part from the sandy formation underlying the loess. It is free from gravel and boulders, but carries a considerable percentage of coarse sand. The quantity of organic matter varies with the color of the soil.

The type occurs in the western part of the county. The largest single area is near Hoskins, and discontinuous areas extend north-westward into Pierce County, being mapped in sec. 31, T. 26 N., R. 1 E. North of this point the type occupies small areas 2 miles north-west of Sholes along the Cedar County line and southwest of Sholes in secs. 7, 18, 19, and 30, T. 27 N., R. 1 E. The Shelby soils are encountered only where the covering of loess has been removed by erosion.

The type in general occupies a sloping position, extending westward from the Logan Creek divide toward the Elkhorn River bottom in Pierce County. The slopes are moderately steep. The soil is lower than the original constructional surface of the Marshall and Knox soils, although not lower than these types as a whole. The type is thoroughly drained and is subject to considerable erosion. Where sufficient organic matter and a high silt content is present the soil retains moisture fairly well, but in general it is much less drought resistant than the Marshall or Knox soils. It formerly was covered with prairie grasses, but only small areas of the original sod remain.

Corn is the leading crop, and average yields of 25 bushels per acre are obtained. Oats are grown extensively, producing 25 to 35 bushels per acre. Alfalfa does fairly well and yields 2 to 3 tons per acre. The soil responds readily to the application of barnyard manure, but the quantity of manure produced is inadequate. Millet yields about 2 tons per acre. This is an early soil, owing to its sandy texture, and it is well suited to the production of vegetables, particularly potatoes, watermelons, and muskmelons, but these are grown for home use. No definite crop rotation is practiced, although there is a general succession from corn to oats and pasture.

Land of this type with included areas of the Thurston fine sand can be bought for \$75 to \$90 an acre, depending on the location and improvements. It constitutes excellent grazing land, and many areas of the steeper slopes are best used for this purpose. The use of manure and the growing of leguminous crops to increase the organic-matter content of the soil are of primary importance.

In the following table the results of mechanical analyses of samples of the soil and subsoil of this type are given:

Mechanical analyses of Shelby fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
373905.....	Soil.....	0.3	3.6	7.7	53.9	14.0	10.9	9.4
373906.....	Subsoil.....	.6	5.6	8.6	40.3	13.7	17.1	14.0

CASS FINE SANDY LOAM.

The Cass fine sandy loam consists of a dark-brown to black fine sandy loam 15 inches deep, underlain by a light-brown to grayish-brown fine sandy loam, which with depth grades into a loose, incoherent fine sand or sand. In places the lower subsoil contains alternating strata of silt loam and fine sandy loam. When dry, and in places low in organic matter, the surface soil has a light-gray to gray color. Occasionally fine gravel is encountered within the 3-foot section. In places the subsoil of the type consists of a gray to almost white fine sand. Areas of Cass very fine sandy loam are irregularly distributed throughout the type, but these can not be separated on account of their small extent. Marginal areas grading into the associated Wabash silt loam contain a relatively high percentage of silt particles imparting a loamy structure to the surface material.

There are also included areas too small for separation, in which the surface 12 inches is a black fine sand. This grades into a grayish-brown fine sand, and at about 20 inches a gray to light-gray fine sand or sand of loose, incoherent structure is encountered. Such areas represent the Cass fine sand.

The Cass fine sandy loam occurs in small strips along the streams of the Elkhorn River drainage system in the extreme western part of the county. The largest single area occurs in the southwestern corner of the county and along the small streams in the vicinity of Hoskins. The type is alluvial in origin, consisting of material derived from the Thurston and Shelby soils of the glacial drift.

For the most part the surface is level, but slight ridges and depressions occur. There is usually a slight gradient from the stream toward the upland and also in the direction of the flow of streams. Both the surface drainage and underdrainage are good. The type lies only 4 to 8 feet above the normal water level of the streams.

Originally some of the soil supported a straggling growth of such trees as cottonwood, willow, and ash. Practically all the type has been cleared, and the land is either in cultivation or in pasture. Untilled areas support a heavy growth of native grasses. The soil is of little importance agriculturally in Wayne County, on account of its small extent. Its chief use is for grazing beef cattle.

Corn, oats, alfalfa, and live stock, mainly beef cattle and hogs, are the principal agricultural products. The cattle and hogs are largely fattened on areas of adjoining upland. The hogs usually are fed in conjunction with the cattle. Corn yields 30 to 45 bushels per acre, oats 30 to 40 bushels, and alfalfa 3 to 4 tons per acre a season.

The soil is easily tilled on account of its open, porous structure. It is seldom too wet for cultural operations. Corn is listed. This

method is more successful on this soil than on the heavier soils. The Cass fine sandy loam is one of the first soils to warm up in the spring. It is well suited to small fruits and vegetables, but these are grown only for home use. For truck crops large quantities of manure are needed. The incorporation of manure or other organic matter greatly increases the water-holding capacity of the soil. Commercial fertilizers are not used. The soil is inclined to be droughty, especially the included areas of fine sand, and on this account cultural methods designed to conserve the moisture supply are needed.

Land of this type usually is held in conjunction with the Thurston and Shelby soils, the value of which it slightly enhances. It is a good corn and grass soil, and its best use is for growing these crops in conjunction with the raising of live stock.

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

Mechanical analyses of Cass fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
373909.....	Soil.....	0.2	2.8	6.7	57.1	11.6	12.9	8.5
373910.....	Subsoil.....	.1	2.8	6.6	64.0	11.9	7.4	7.0

WABASH SILT LOAM.

The soil of the Wabash silt loam to an average depth of 15 inches consists of a black silt loam containing large quantities of organic matter. It is underlain by a dark brownish drab silt loam to silty clay loam, which grades between 24 and 30 inches into a heavier silty clay loam to silty clay. Occasionally the subsoil is dark-gray silty clay, and the color of the material usually becomes lighter in the lower part. Deep cuts along drainage ways show the subsoil below about 4 feet to be a light-gray, heavy silt loam, mottled with brownish iron stains.

The type has a number of variations. These are of irregular occurrence and not sufficiently conspicuous or extensive to warrant separate mapping. In many places the soil shows no appreciable change in color or texture throughout the 3-foot section, being a black to dark-brown silt loam. Some small areas of dark-brown silt loam occur at the foot of the slopes leading from the loessial upland. The soil here consists of colluvial material washed down and deposited as a surface covering over the alluvial silt loam. The subsoil of these areas usually is more compact than the typical. Such areas are from 2 to 3 feet higher than the typical lowland and are above

normal overflow. The type also includes colluvial fans at the mouths of small streams issuing into the main bottoms.

An important variation of the type consists of a black to very dark-brown silty clay to a depth of 12 or 14 inches, grading abruptly into a drab or mottled drab and yellowish-brown, plastic clay which continues throughout the remainder of the 3-foot section. In places the heavy clay subsoil lies below a depth of 18 inches. Only two small areas of the variation are mapped in Wayne County, one in sec. 4, T. 26 N., R. 4 E., and the other in sec. 4, T. 26 N., R. 5 E. The total area does not exceed 75 acres. If it were more extensive this soil would be mapped as the Wabash silty clay loam. It is slightly lower than the typical Wabash silt loam, and drainage is deficient. About 50 per cent is cultivated, the remainder being in pasture or wild hay land. The soil is subject to overflow and crops are sometimes lost. It is a good pasture soil and yields from 2 to 3 tons of wild hay per acre. Bluegrass and wild clover grow luxuriantly. The establishment of good drainage is the main requisite. On account of its heavier texture tillage operations are more difficult on this soil than on the typical silt loam.

Throughout the type there are small areas having a typical surface soil, but underlain at 20 to 25 inches by a heavy, plastic silty clay to clay. Another subsoil variation occurs in which the material below about 25 inches consists of alternating layers of silty clay, silt loam, and very fine sandy loam. The subdrainage of areas with the light-textured subsoil material is better than that of areas with clay substrata.

In some irregularly distributed small areas the surface soil is a dark-gray or ashen-gray, heavy silt loam underlain at shallow depths by an almost black to drab, plastic clay loam or clay. The surface material quickly dries out to a hard white crust. Such areas are locally referred to as "alkali spots." The spots usually vary in size from one-tenth to 1 acre. They usually occupy poorly drained situations. The yield of crops on those areas is much below the average for the type, although there are no total crop failures. Corn seems to be most susceptible to injury. Oats usually make a rank growth and commonly lodge, but the yields of grain are not proportionate to the straw produced. The saline condition is caused by a concentration of salts in the surface soil, to which they are carried in solution through capillary action of the soil water.

In poorly drained situations at the foot of the slopes of the upland there is a peaty covering a few inches deep over the silt loam. These areas occur where there is considerable seepage from the upland.

The Wabash silt loam is the most extensive bottom-land type in Wayne County. It occurs as long, narrow strips along all the

streams. The material composing the soil is of alluvial origin, having been washed from the adjoining loessial upland, carried by the streams, and deposited within the present flood plain. A rank vegetation developed under the moist conditions, and the decay of this accounts for the dark color and the high organic-matter content of the type. The flood plains of some of the smaller streams are quite narrow, and in places a slight exaggeration is necessary to show this type on the soil map. The flood plains are 10 to 15 feet above normal water level.

The surface is generally flat except where relieved by old cut-offs or slight elevations. However, there is a range in elevation of 2 to 4 feet, which affects quite materially the agricultural value of the land on account of overflow conditions. The gradient of Logan Creek, the main drainage way, is slight. Drainage of the type as a whole is extremely variable, large areas having adequate drainage while equally extensive areas are very deficient in drainage. The lower areas largely have poor drainage. Rain water accumulates on the surface, and on account of the heavy plastic subsoil it percolates slowly. Frequently small streams from the upland carry the surface run-off from large areas to the edge of the valley, where on account of the decreased velocity of the current the channel of the stream becomes filled with sediment, leaving the water to spread over the surface. The type is subject to occasional overflows, which sometimes cause crop loss. The drainage of some parts of this soil has been improved by tiling. An example of the success attending tile drainage is found 1 mile east of Winside in sec. 1, T 25 N., R. 2 E., where areas which were formerly too poorly drained for profitable cropping, have by tiling been converted into very productive land, yielding 65 to 70 bushels of corn and 5 tons of alfalfa per acre per season.

The Wabash silt loam is one of the most productive soils in the State, and were it not for the overflows that greatly reduce the average yields it would doubtless rank as one of the best soils in this county. In a way the occasional overflows serve to improve the type, as each inundation leaves an additional deposit of rich soil material over the surface.

Originally all this soil was covered with water-loving grasses. In a few places narrow strips along the main streams were forested with ash, low willow, and cottonwood. At present about 50 per cent of the type is in cultivation and the remainder constitutes valuable pasture land with bluegrass, white clover, and wild grasses as the main growth. White clover makes a luxuriant growth. Cultivation is largely confined to the higher-lying, better-drained areas. Corn is the leading crop, but wheat, oats, alfalfa, red clover, and alsike also

are important. The average yields of crops on the better drained land exceed those for the county as a whole. The type is regarded as the strongest corn soil in the county, and it withstands continuous cropping to corn better than any other soil. Short-strawed varieties of oats are grown, as the crop has a tendency to lodge. Turkey Red is the principal variety of wheat. Alfalfa and red clover are grown on only the better drained areas, but the drainage of all the type can be so improved as to make the growing of these legumes profitable except in areas subject to frequent overflow. Where the water table is within 4 feet of the surface a stand of alfalfa can not be kept so long as on the higher lying areas. Alsike does well in the poorly drained areas of this soil. The crop is grown successfully in the vicinity of Wayne. The live-stock industry is becoming more important. Large numbers of beef cattle are pastured on the type and hogs are raised in an important way, particularly where poorly drained areas of the type are held in conjunction with upland soils. A one-crop system prevails on this soil, although corn occasionally is rotated with oats, wheat, and pasture. It is not uncommon for a field to be in corn for seven or eight years in succession. A rotation used on a few of the best farms consists of corn two or three years, followed by oats or wheat one year, after which the land is seeded to clover and timothy, which is left from one year to three years before returning the field to corn. Corn is prevailingly listed, but this seems to be a poor method on this soil because the water stands in the furrows and frequently drowns out the crop.

Corn yields from 50 to 70 bushels per acre, oats 40 to 65 bushels, wheat 30 to 35 bushels, and alfalfa about 5 tons per acre per season. Alsike yields 3 tons per acre and clover and timothy from $1\frac{1}{2}$ to 3 tons. Wild hay produces 1 ton to 2 tons per acre. Where manure is applied yields of all crops are considerably increased.

The silty character and friable structure of the type, together with the smooth topography, make cultivation easy. However, this soil can not be worked under so wide a range of moisture conditions as the upland silt loams, and if plowing is done when it is too wet it bakes and forms clods which are difficult to pulverize. The soil usually must dry a day longer after heavy rains than the upland soils before tillage operations are possible. Large areas of the type are still in the original sod and are either pastured or used for the production of wild hay. These areas usually occupy the lowest parts of the bottoms, although some areas of relatively high position are pastured. The lower areas are most deficient in drainage. Areas of very poor drainage are covered with water-loving grasses, such as Wyoming bluegrass, blue stem, and slough grass. The yield of wild hay decreases to a slight extent where cut annually for a period of years, but by pasturing or manuring the grass is quickly rejuvenated.

The Wabash silt loam is a very drought-resistant soil, and crops seldom suffer from lack of moisture. The continued cropping to corn on many farms has resulted in decreased productiveness, but yields have not declined to such an extent that the production of corn is unprofitable.

The value of the Wabash silt loam ranges from \$125 to \$200 an acre, depending on location and drainage conditions. Few farms are composed entirely of this type.

The chief problem confronting the farmers on large areas of this soil is that of drainage, although the prevention of overflows also is important. Drainage can be provided by constructing ditches and laying tile laterals. Protection from floods is more difficult to accomplish, and the expense of building levees and diking under present conditions is not always justified, especially in view of the fact that the land has a high value for grazing without this improvement. On many farms the acreage of this soil is sufficient to supply pasturage, the farm crops being grown on the upland. The period of overflow may be considerably shortened, and the danger of crop loss lessened in many areas of the type by straightening the stream channels and ditching.

Apparently the acreage in corn is proportionately too great and that in leguminous crops too small for a well-balanced system of farming. This is largely due to the difficulty of feeding live stock on the bottom land, where it is difficult to find feed lots which are not too muddy. It is necessary, therefore, in order to maintain an adequate organic-matter supply of the soil, to plow under crop residues and leguminous crops as often as possible. It is only because of its high natural productiveness that the Wabash silt loam has retained its fertility under the exhaustive system of corn production that has been practiced. However, there is evidence that some of this soil is becoming deficient in organic matter and in places light-colored, unproductive spots are appearing. The only remedy for such areas, where liberal quantities of manure are not available, is the incorporation of vegetable matter, preferably in the form of legume crops. Where alfalfa and red clover can not be grown on account of poor drainage conditions alsike is a good substitute. The high, well-drained areas are well suited to alfalfa and red clover, and with an extension of their acreage and the application of manure to the land the type can be kept permanently productive without the addition of commercial fertilizers.

SUMMARY.

Wayne County, Nebr., lies in the northeastern part of the State. It has a total area of 450 square miles, or 288,000 acres. About three-

fourths of its area is upland, one-eighth bottom land, and the remainder terraces. The topography is uneven, varying from hills through rolling relief to gently undulating and smooth areas. The hilly belt is in the southwestern part of the county, and the smooth areas in the southeastern and eastern parts, the remainder being rolling. The bottom lands lie mainly between 1,450 and 1,575 feet above sea level, and the uplands are only about 160 feet higher at the highest points.

Drainage is well established, except in depressed areas, mainly in the bottoms. The Logan Creek and Elkhorn River drainage systems carry the drainage waters. These streams empty into the Platte River after converging in Dodge County.

Wayne County was organized in 1870. The early settlers came largely from the Central and Eastern States. Over 85 per cent of the total population is of native birth. The population of the county in 1910 is reported as 10,397, all of which is classed as rural. Wayne, the county seat, has a population of about 2,200. It is the main marketing and distributing point for the farm products of the county.

The county has good transportation facilities and the markets of Sioux City, Omaha, and Lincoln are within easy reach of the farmers. A comprehensive public road system reaches all the farming communities.

The climate of Wayne County is well suited to general farming. The mean annual temperature is 47.7° F., and the mean annual precipitation 27.72 inches. The rainfall is generally quite favorably distributed throughout the growing season. The summer months June, July, and August receive about 40 per cent of the rainfall. The average length of the growing season is 144 days.

Agriculture is the basic industry in Wayne County. Grain production in conjunction with live stock has been the leading type of farming since the settlement of the region. The principal crops are corn, oats, alfalfa, clover, timothy, wheat, and wild hay. The corn, oats, and hay produced are principally used on the farm, but wheat is grown as a cash crop. Over 37 per cent of the total acreage of the county was devoted to corn in 1909. Stock farming is increasing in importance. Large numbers of beef cattle and hogs are sold or slaughtered annually, and Wayne County ranks in proportion to size as one of the leading counties in the State in live-stock production. The breeding of draft horses receives some attention on nearly all the farms.

The common crops are grown indiscriminately on all the soils but the yields obtained vary greatly on the different types. Only the more progressive farmers follow a systematic crop rotation. The

methods of farming are gradually being improved. The farm dwellings are substantial and are kept in good condition, and the barns are large. The work stock consists of heavy draft horses, and improved farm machinery is in general use. Farm land sells for \$100 to \$200 an acre. The average value over a large part of the county is \$145 to \$150 an acre. The farmers throughout the county are prosperous.

The soils of Wayne County may be separated on the basis of origin and method of formation into three general groups: (1) Loessial soils, or soils derived by weathering from the loess, or silt covering of the upland plain, (2) soils derived from unconsolidated glacial drift deposits, and (3) sedimentary soils composed of material washed from the surrounding upland and deposited over stream flood plains or in basinlike depressions. The loessial soils are the most important and cover about three-fourths the total area of the county. They are mapped as the Marshall silt loam, a black loess soil, and the Knox silt loam, a light-brown loess soil. These soils are well drained and are very productive. The prevention of erosion is the most important problem in their management. They are well suited to a wide range of crops. Grain farming and the production of leguminous hay and live stock, chiefly beef cattle and hogs, are highly specialized industries.

The glacial-drift soils are classed as the Shelby fine sandy loam and the Thurston fine sand. These types occur only on slopes where the loessial deposit has been eroded away. They are less productive than the loessial soils, and of small extent. They are well drained, but low in organic matter, and need careful farming, including the incorporation of large quantities of organic manures, to be kept in a productive condition.

The terrace, or second-bottom soils of the sedimentary group are recognized as the Waukesha silt loam and the Waukesha loam. These soils are well suited to the production of all the leading crops of the county and rank with the loessial soils in productiveness. They comprise some of the best land in Wayne County.

The sedimentary soil of the depressions on the terraces and the upland is mapped as the Scott silt loam. It is very deficient in drainage, but is productive.

The sedimentary soils of the first bottoms or present flood plains of streams are classed as the Cass fine sandy loam and the Wabash silt loam. The Cass fine sandy loam, although less productive than the Wabash soils, produces good yields of all the staple crops. It is well drained. The Wabash soils are highly productive; they constitute some of the best land in the State. Drainage, however, is poor in places, and renders a part of these soils unsuitable for cropping

but such areas are very valuable for grazing. Bluegrass and white clover grow luxuriantly. The bottoms occasionally overflow, causing damage to crops. Tiling and ditching is very profitable on large areas of these soils.

The cropping systems employed in this county are in general not well designed to maintain the productiveness of the soils. There is a general need for growing legumes more extensively in the rotation and for more attention to systems of green manuring to increase the organic-matter supply. Although good yields of crops are obtained under the prevailing methods, the average production is below that which might reasonably be expected from soils so high in natural productiveness and so well suited to such crops as alfalfa and clover. All the soils seem to be high in lime content.



[PUBLIC RESOLUTION—No. 9.]

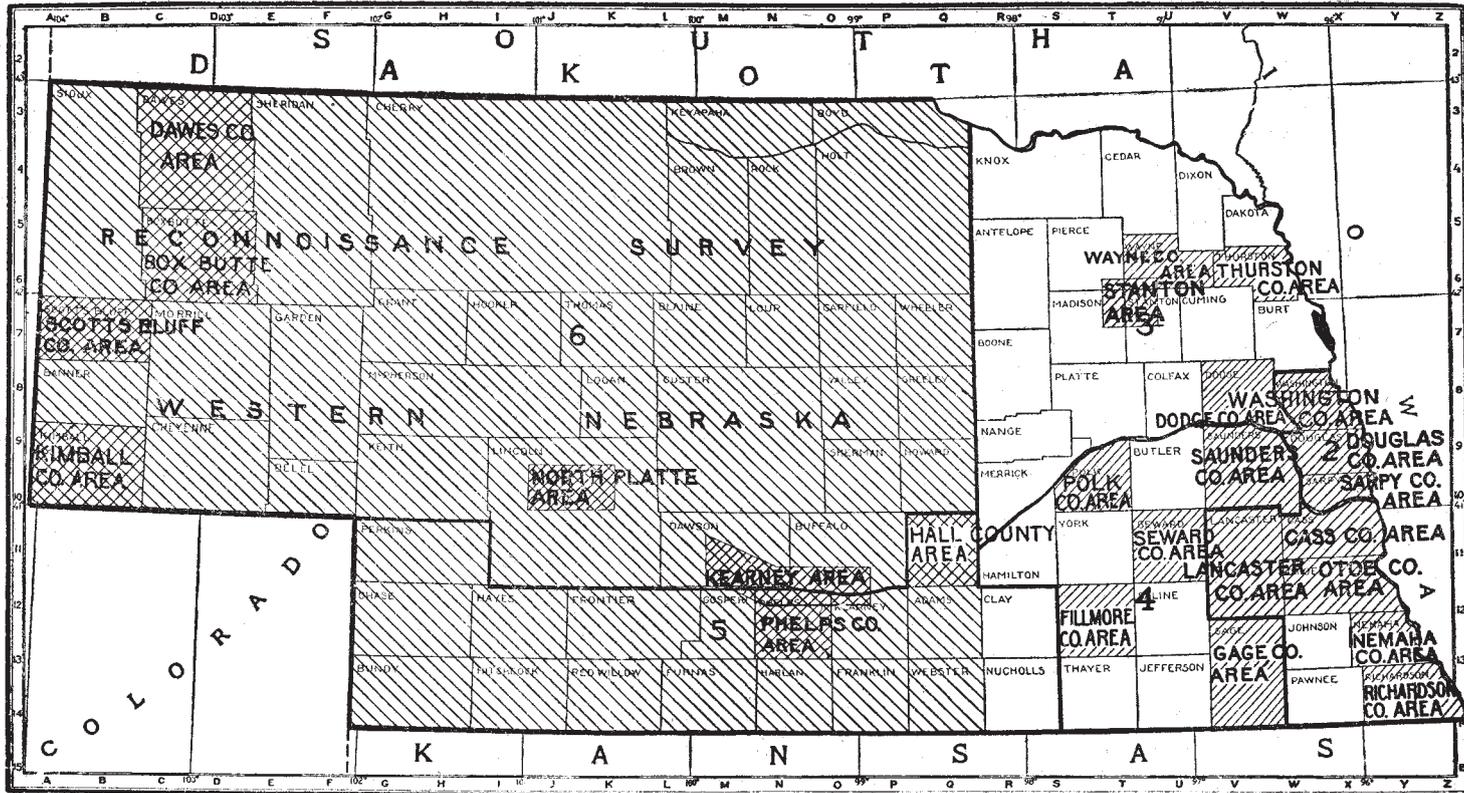
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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

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

Approved, March 14, 1904.

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



Areas surveyed in Nebraska.

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