Sarpy County
Nebraska

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UNITED STATES DEPARTMENT OF AGRICULTURE
In cooperation with the University of Nebraska
State Soil Survey Department of the Conservation and
Survey Division

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Map.
SOIL SURVEY OF SARPY COUNTY, NEBRASKA

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United States Department of Agriculture, in cooperation with the University of Nebraska, State Soil Survey Department of the Conservation and Survey Division

COUNTY SURVEYED

Sarpy County, the smallest county in Nebraska, is between the Missouri and Platte Rivers on the east-central border of the State (fig. 1). Papillion, the county seat, is only a few miles southwest of Omaha. The county is roughly rectangular, although river boundaries on its east, west, and south sides make it somewhat irregular in shape. The eastern boundary is not definitely established in places. The county has an average east-west length of about 22 miles and an average north-south width of 11 miles. It comprises 240 square miles, or 158,600 acres.

The county lies in the Central Lowland section of the Great Plains physiographic province. It is part of a former drift-capped plain that covered eastern Nebraska. Following the melting of the last, or Kansan, glacier the plain was subjected to severe erosion which removed the glacial deposits in places, exposing the underlying bedrocks, and over most areas produced a strongly rolling to hilly relief. Later the modified surface of the drift plain was blanketed to various depths with two wind-blown deposits. The first was the Loveland loess, a pale-red slightly sandy silt, which was considerably eroded before the last, or light-gray silty and floury Peorian loess, was laid down. These loess deposits covered the smaller irregularities and considerably reduced the harshness of the larger ones. Within the county, subsequent erosion by the Missouri, Platte, and Elkhorn Rivers, and their local tributaries, modified the original surface of the upper loess mantle and removed all loess along some of the deeper drainageways, exposing the underlying glacial drift, Dakota sandstone, and Pennsylvanian limestone, named in order of their occurrence from top to bottom.

Uplands occupy about 77 percent of the total area of the county, and stream terraces and flood plains the rest. Throughout the uplands the relief ranges from undulating to extremely rough and
broken. The most nearly level upland areas are near the top of a main divide which extends northward from Gretna in the western part of the county and eastward from Gretna nearly across the central part. Even on the top of this divide there are only a few quarter sections (160 acres each) in which the local differences in relief are less than 40 feet. Southward and northward, on the slopes leading toward the Platte River and Big Papillion Creek, respectively, the terrain is cut by an intricate system of narrow V-shaped drainageways, and the land becomes increasingly hilly. The roughest areas are in a strip of bluff land, ranging from $\frac{1}{2}$ to 2 miles in width, bordering the valley floors along the Missouri, Platte, and Elkhorn Rivers on the eastern, southern, and western sides of the county. Throughout most of this strip the terrain has been carved into a succession of sharp-topped divides separated by narrow deep valleys with extremely steep slopes, and glacial drift and the underlying sandstone and interbedded limestone and shale bedrocks are exposed on some of the lower valley sides. An area known as Bellevue Bluffs, comprising about 5 square miles north of Bellevue and east of Avery, has the most pronounced relief.

Alluvial lands, including terraces and flood plains, border all the larger and many of the smaller drainageways. The widest areas of such land are along the Missouri and Platte Rivers, where they attain a width exceeding 2½ miles in places.

The terraces or benches, which occupy less than 10 percent of the alluvial lands, were formed before the streams became so deeply entrenched, and they lie at several different levels. The higher ones remain only as remnants, of which one of the highest is between Bellevue and Fort Crook, where the top of the terrace is about 60 feet above the Missouri River bottoms. Other high remnants are in the vicinities of Papillion and Melia, north of Bellevue, and southwest of Gretna. Lower terraces, few of which lie more than 25 feet above the adjoining flood plains, are in and near Papillion, west of Gretna, northeast of Meadow, and in the vicinity of Portal. Most of the higher benches are undulating, whereas the lower ones are nearly level.

The flood plains, which include most of the alluvial lands, occupy the lowest positions in the county. They lie only a few feet above the streams and are practically level except where the land surface is modified by old and active stream channels, cut-offs, slight elevations, and shallow depressions.

Drainage is effected eastward and southward to the Missouri River, and the county, as a whole, is well drained. Throughout much of the uplands, run-off is rapid and gullies have become a serious problem in many of the cultivated fields. The flood plains include some poorly drained tracts, most of which have been ditched or tiled in places where the soil is suitable for tilled crops.

The smaller creeks and branches throughout the uplands are swift-flowing and are actively deepening their channels, but the larger streams are rather sluggish and are depositing sediment at places. Dikes have been constructed in places along Elkhorn and Platte Rivers, in order to prevent the bottom lands from becoming flooded during periods of high water. The channel of Big Papillion Creek has been dredged and straightened, and some of the drainageways, tributary to the rivers, flow in ditched channels across the flood plain.
of the trunk stream. The Missouri River is confined by revetments designed to prevent erosion of its banks and to deepen and straighten its channel for navigation.

The average elevation of the uplands is about 1,150 feet above sea level, and that of the flood plains along the Missouri and Platte Rivers is about 1,000 feet. The highest point in the county, about 1,300 feet, is on the divide north of Gretna in the northwestern part, and the lowest, about 950 feet, is at the junction of the Platte and Missouri Rivers in the extreme southeastern corner. The elevation \textsuperscript{1} at Papillon is 1,025 feet; at Gretna, 1,247 feet; at Springfield, 1,064 feet; at Chalco, 1,073 feet; at Meadow, 1,007 feet; at La Platte, 970 feet; at Gilmore, 988 feet; at Avery, 1,019 feet; and at Bellevue, 985 feet. In general the land slopes toward the southeast.

Well water of good but medium-hard quality is readily obtained over most of the county in quantities sufficient for family and livestock needs. On the uplands it is obtained mainly from lenses and buried channels of sand and gravel in the drift deposits, but partly from sandstone, limestone, and sandy shale bedrocks. The supply from the limestones with their interbedded shales generally is small and rather uncertain. Throughout most of the uplands, water is reached at a depth ranging from 60 to 100 feet. In parts of the bluffs along the Missouri and Platte Rivers the bedrocks are near the surface and considerable prospecting is necessary before a satisfactory well can be obtained. Some farmers in these areas obtain water from springs issuing from aquifers in the drift or bedrocks. On the terraces few wells exceed 60 feet in depth, and on the flood plains along the Missouri and Platte Rivers an abundance of good water is available within a depth of 20 feet.

Little thought has been given to the location and care of the wells, and it is not uncommon to see shallow wells immediately below feed yards and other sources of contamination. Many of the wells are poorly cared, and some are open and receive wind-blown sediment and surface debris from surrounding land.

This county is in the Prairie soil region of the United States. Before settlers arrived, nearly all of the uplands supported a luxuriant growth of prairie grasses, and most of the valley slopes along the Missouri and Platte Rivers and along the lower course of Big Papillion Creek were forested. Nearly all of the virgin sod, except on the steeper and more stony slopes, has been broken for cultivated crops or orchards, and most of the forested areas have been cut over at least once. The native grass vegetation on scattered virgin tracts throughout the uplands consists mainly of prairie beardgrass (little bluestem), porcupine grass (needlegrass), side-oats grama, junegrass, and prairie dropseed. On the flood plains, big bluestem, tall panic grass, Indian grass, and wild-rye are abundant in the better drained virgin areas, and sloughgrass and sedges grow in the poorly drained situations. Since early settlement bluegrass has become established and is now abundant over much of the pasture and hay land.

The natural forest growth is confined mainly to nonarable areas, such as the bluff lands, recently deposited sediments along the rivers, and to narrow strips on the valley sides and flood plains of some of the smaller drainageways. In the rougher areas the native trees are

\textsuperscript{1} \textit{Gannett, Henry. A dictionary of altitudes in the United States. U. S. Geol. Survey Bull. 274, ed. 4, 1972 pp. 1966.}
largely bur oak, red oak, black oak, ironwood, linden, and hickory, interspersed with honeylocust, black cherry, and here and there a red cedar tree. On the nonarable parts of the flood plains and lower valley slopes, elm, ash, walnut, hackberry, boxelder, cottonwood, and willow are abundant, with sycamore trees occurring as scattered individuals. Northward-facing slopes generally support the most luxuriant growth and the largest variety of trees and shrubs.

The first permanent settlement in the area now included in Sarpy County was made in 1810 when the American Fur Co. established a trading post at the present site of Bellevue. In 1823 an Indian agency also was located at this place. When Nebraska was made a territory in 1854 the trading post became the town of Bellevue; Douglas County was established by the Territorial Legislature; and the entire section was open to settlement. Early development was slow until the completion of the land surveys in 1856 when the settlers, then known as “squatters,” were given preemption rights to 160 acres of surveyed land and began to improve their holdings. In 1857 the southern part of Douglas County was taken to form Sarpy County, which was named after Peter A. Sarpy, an agent for the fur company. During that year a steam ferry was established across the Missouri River near Bellevue, the first county seat, and the influx of settlers was rapid, mostly of American or German birth, from Iowa and other States to the east.

The Federal census reported 4,481 inhabitants in the county in 1880. According to subsequent census records, the population has increased steadily, and by 1930 was 10,402, all classed as rural. The average density in the latter year is given as 43.3 persons a square mile. Settlement is densest in the northeastern corner near Omaha and in the vicinity of the towns. The sparsest settled sections are on the flood plains along the rivers and in parts of the bluff lands.

Bellevue, with 1,017 inhabitants in 1930, is the largest town. Papillion, founded in 1869, was made the county seat in 1875 and in 1930 had a population of 718. The other towns, with less than 500 inhabitants each, are of local importance as markets and distributing centers for farm produce and supplies.

Transportation facilities are good. Railroads and paved, graveled, or rock-surfaced highways cross the county in several directions connecting all towns with Omaha, the main market for the surplus grain and livestock. Several of the minor roads are surfaced with gravel, although most of them are of earth construction. They follow land lines except in the rougher sections where they conform to the relief. All public roads are kept in good repair. Cement bridges and culverts are common.

Rural mail delivery routes reach all sections. Telephones are on most farms and the public-school system is highly developed.

The only nonagricultural industries carried on include rock quarrying, gravel dredging, and the production of fish for stocking the streams and lakes of Nebraska. One of the largest fish hatcheries in the State is located 8 miles south of Gretna along Platte River. Limestone quarries are located near Richfield and Meadow and at several places along Platte River in the bluffs west of Meadow. Most of the limestone, which is medium hard, is crushed for use in concrete structures and in surfacing roads. The gravel is obtained from the Platte River flood plain in the vicinities of Meadow and La Platte
and is used mainly for road surfacing. These three industries employ from 50 to 100 men annually. Meat-packing plants near Omaha in Douglas County to the north supply labor for many of the inhabitants in the northeastern part of Sarpy County.

CLIMATE

The climate is continental and temperate, with rather wide seasonal variations in temperature and precipitation between winter and summer, as is typical of the Corn Belt. It is well suited for the raising of livestock and the production of grain and hay crops common to this section. The springs are cool, with considerable rainy weather which favors the rapid growth of pasture grasses, winter wheat, and spring-planted grains. The summers are long with moderate precipitation and warm days and nights, which are especially favorable to the growth of corn. Low temperatures occur during the winter but are of short duration and are usually accompanied by snow which covers the ground from 30 to 60 days annually and protects winter-grown crops from serious injury. The autumns are long and pleasant, with only occasional periods of rainy weather, giving the farmer ample time to prepare and seed the land for winter wheat and to harvest the corn crop. Differences in relief are not sufficient to cause appreciable differences in climatic conditions within the county.

Table 1, compiled from the records of the United States Weather Bureau station gives the normal monthly, seasonal, and annual temperature and precipitation at Ashland, Saunders County, Nebr., where climatic conditions are believed to be similar to those existing over Sarpy County as a whole.

Table 1.—Normal monthly, seasonal, and annual temperature and precipitation at Ashland, Saunders County, Nebr.

[Elevation, 1,120 feet]

<table>
<thead>
<tr>
<th>Month</th>
<th>Temperature</th>
<th>Precipitation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Absolute maximum</td>
</tr>
<tr>
<td></td>
<td>°F.</td>
<td>°F.</td>
</tr>
<tr>
<td>December</td>
<td>39.9</td>
<td>69</td>
</tr>
<tr>
<td>January</td>
<td>33.4</td>
<td>69</td>
</tr>
<tr>
<td>February</td>
<td>26.5</td>
<td>80</td>
</tr>
<tr>
<td>Winter</td>
<td>25.6</td>
<td>80</td>
</tr>
<tr>
<td>March</td>
<td>39.1</td>
<td>91</td>
</tr>
<tr>
<td>April</td>
<td>52.0</td>
<td>100</td>
</tr>
<tr>
<td>May</td>
<td>62.1</td>
<td>100</td>
</tr>
<tr>
<td>Spring</td>
<td>51.1</td>
<td>100</td>
</tr>
<tr>
<td>June</td>
<td>47.6</td>
<td>105</td>
</tr>
<tr>
<td>July</td>
<td>77.0</td>
<td>112</td>
</tr>
<tr>
<td>August</td>
<td>75.0</td>
<td>109</td>
</tr>
<tr>
<td>Summer</td>
<td>74.5</td>
<td>112</td>
</tr>
<tr>
<td>September</td>
<td>47.6</td>
<td>112</td>
</tr>
<tr>
<td>October</td>
<td>55.0</td>
<td>107</td>
</tr>
<tr>
<td>November</td>
<td>39.6</td>
<td>80</td>
</tr>
<tr>
<td>Fall</td>
<td>53.8</td>
<td>105</td>
</tr>
<tr>
<td>Year</td>
<td>51.3</td>
<td>112</td>
</tr>
</tbody>
</table>

1 Trace.
The average date of the last killing frost is April 26 and of the first is October 11. This gives an average frost-free season of 168 days which is ample for the maturing and harvesting of all crops commonly grown. Killing frosts have occurred as late as May 25 and as early as September 12. During the 20 years from 1895 to 1914 there were 4 years in which killing frosts occurred 10 or more days earlier in the fall than the average date and 4 years in which they were 10 or more days later in the spring.²

The annual precipitation fluctuates greatly from the yearly average of 27.09 inches. It was less than 85 percent of the mean annual amount in about one-fourth of the years 1895 to 1914, inclusive.³ About 84 percent of the mean annual precipitation falls from April to October, inclusive, which comprises all the growing season. In summer most of the precipitation occurs as heavy thundershowers, but torrential rains are rare. Nearly all of the soils have high moisture-holding capacities, and although the rainfall is deficient at times during middle and late summer, crops seldom are injured seriously because of lack of moisture. Hail may damage crops over small areas in some years, but injury from this source is local and does not reduce the total county yields to a great extent.

From about October 1 to April 1 the prevailing wind is from the northwest, and during the rest of the year it is from a southerly direction. The average velocity of the wind at Omaha, just outside the northeastern corner of the county, is 9 miles an hour at an elevation of about 100 feet. Strong winds ranging from 30 to 50 miles an hour are common, but tornadoes are rare.

The relative humidity is fairly regular, the average for the year being about 70 percent. During the period 1895 to 1914, inclusive, the number of clear days ranged between 120 and 160 annually.⁴

AGRICULTURE

Prior to the first permanent settlement in 1810, the area now included in Sarpy County was occupied by Indians and a few hunters and trappers, who subsisted largely on wild game, fish, and fruit. During the next 40 years the principal industry was fur trading at Bellevue, where furs collected along the upper Missouri and Yellowstone Rivers were purchased for shipment to St. Louis. A few squatters located holdings during this period, mostly along streams where water and fuel were plentiful, in the country around Bellevue, but notable agricultural development did not take place until 1857 when the land survey had been completed and the county was organized. At first only those crops were grown that were required to supply the immediate family needs. The number of livestock was small, and the farm animals grazed on the luxuriant prairie grasses of the unfenced range.

Corn has occupied the leading acreage since farming began. Until 1867 considerable spring wheat was grown, but this was replaced gradually by winter wheat, which gave higher yields and ranked next to corn in acreage, until the price of wheat began to fall, with the development of new wheat-growing sections in the North. Con-

⁴ See footnote 3, supra.
Considerable wheat is still grown for cash, but, as the number of livestock increased, the area devoted to wheat was surpassed by that used for oats and has remained rather low except for a short period during the World War.

Table 2, compiled from Federal census data, gives the acreage devoted to the principal crops grown in this county in 1879, 1889, 1899, 1909, 1919, 1929, and 1934 and shows the general trend of agriculture during the last 55 years.

<table>
<thead>
<tr>
<th>Crop</th>
<th>1879</th>
<th>1889</th>
<th>1899</th>
<th>1909</th>
<th>1919</th>
<th>1929</th>
<th>1934</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>33,942</td>
<td>44,264</td>
<td>59,797</td>
<td>40,564</td>
<td>47,605</td>
<td>61,647</td>
<td>6,501</td>
</tr>
<tr>
<td>Oats</td>
<td>6,254</td>
<td>13,543</td>
<td>17,458</td>
<td>15,884</td>
<td>14,520</td>
<td>16,002</td>
<td>9,648</td>
</tr>
<tr>
<td>Wheat</td>
<td>9,697</td>
<td>3,267</td>
<td>8,103</td>
<td>9,460</td>
<td>20,500</td>
<td>7,225</td>
<td>4,477</td>
</tr>
<tr>
<td>Rye</td>
<td>212</td>
<td>522</td>
<td>558</td>
<td>79</td>
<td>200</td>
<td>120</td>
<td>592</td>
</tr>
<tr>
<td>Barley</td>
<td>1,241</td>
<td>1,594</td>
<td>315</td>
<td>390</td>
<td>1,803</td>
<td>955</td>
<td>720</td>
</tr>
<tr>
<td>Potatoes</td>
<td>1,155</td>
<td>1,200</td>
<td>1,209</td>
<td>1,206</td>
<td>656</td>
<td>654</td>
<td>787</td>
</tr>
<tr>
<td>Hay (all kinds)</td>
<td>7,185</td>
<td>16,557</td>
<td>13,237</td>
<td>13,915</td>
<td>13,134</td>
<td>8,847</td>
<td>10,551</td>
</tr>
<tr>
<td>Tame hay</td>
<td>8,145</td>
<td>4,292</td>
<td>3,157</td>
<td>4,199</td>
<td>454</td>
<td>1,048</td>
<td></td>
</tr>
<tr>
<td>Alfalfa</td>
<td>397</td>
<td>3,334</td>
<td>6,302</td>
<td>5,947</td>
<td>7,526</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clover</td>
<td>919</td>
<td>1,082</td>
<td>1,476</td>
<td>1,238</td>
<td>475</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All other tame hay</td>
<td>3,875</td>
<td>5,201</td>
<td>2,196</td>
<td>454</td>
<td>1,246</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Incl udes some tame grasses.

Corn, although somewhat restricted in acreage under recent soil conservation practices, still occupies about one-third of the total land area. It is followed by oats, wheat, alfalfa, barley, and rye, ranking in acreage, during most years, in the order named. Minor crops include kafr, potatoes, Sudan grass, millet, vegetables, and fruits.

Crop yields differ from year to year, in accordance with differences in the amount and distribution of precipitation and the length of the frost-free period. They also differ widely on different soils. For the county as a whole, however, the average yields of crops over long periods are fairly uniform.

According to the Federal census reports, corn was harvested for grain on about 96 percent of its acreage in 1929 and on only about 13 percent in 1934. This difference was due mainly to the drought during the latter year when all crops suffered severely. The average yield of corn was reduced to about 9 bushels an acre, which caused most of the farmers to cut the crop for fodder or silage.

The total value of all crops produced in 1929, including vegetables grown for home use and forest products cut on farms, was $2,999,148, and the total value of livestock products, including butter, cream, and whole milk sold, poultry raised, chicken eggs produced, and wool clipped, was $785,648. The value of all domestic animals on the farms was $1,560,157 on April 1, 1930.

Table 3, compiled from the Federal census reports, gives the number and value of domestic animals and poultry in 1910, 1920, 1930, and 1935, so far as the data are available.
The 1935 Federal census reports 1,153 farms in the county, or 91 more than were reported in 1930. They occupied 93.1 percent of the total land area. Most of the farms range in size from 80 to 320 acres, and the average size is 124 acres. Many holdings in the northeastern part of the county, where fruit and vegetables are grown for sale in Omaha, include only a few acres each. In 1929 crops were harvested on about 66 percent of the land, but in 1934 the great drought reduced yields to such an extent that crops were harvested on only about 52 percent of the land. During the latter year crop failure was reported on 15,704 acres, and 9,520 acres of cropland remained idle. These figures contrast sharply with those reported for 1929, when crops failed on only 2,702 acres and only 2,304 acres of cropland were idle.

The farm buildings, in general, are well painted and kept in good repair. Most of the houses are two-story wooden structures. As a rule, barns and other buildings are large enough to house all crops except hay, which is generally stacked in the field. The Nebraska State agricultural statistics show that in 1930, 180 farmhouses had modern heating plants, 199 had running water, 148 were equipped with electricity, and 405 had radios. All farms are fenced, mainly with barbed wire, although many are enclosed with hog-tight woven-wire fencing.

The work animals include heavy draft horses and mules. The farm machinery is of the most modern and labor-saving types. There were 330 gas engines, 365 tractors, 230 trucks, 891 automobiles, 58 grain threshers, 3 wheat combines, and 342 cream separators on the farms in 1930, according to the Nebraska State agricultural statistics. Many farms are equipped with corn binders, corn shuckers, hay balers, incubators, and silos. The more expensive farm machinery is sheltered.

In general, farm laborers are plentiful, and the wages paid have been low, especially during the last few years. The current monthly wages during the summer range from $20 to $30 with board and lodging and during the winter are about $15. Day labor is plentiful at $1 to $2, although as high as $3 a day is paid during the small-grain harvest season. Corn shuckers receive 3 to 4½ cents a bushel. Only a few farmers hire help throughout the year.

The 1935 Federal census shows that owners operate 41.5 percent, part owners 14.5 percent, tenants 43.3 percent, and managers 0.7 percent of the farms. According to the Nebraska State agricultural statistics, in 1930, 41 percent of the rented farm acreage was rented for cash and the remainder for a share of the crops. Under the cash
system of rental, the tenant pays from $6 to $8 an acre for the better grade of farm land and from $3 to $5 an acre for pasture and native-hay land. Under the share system the owner receives two-fifths of the small grain and one-half of the corn and alfalfa. All seed, labor, and machinery are furnished by the tenant. Only a small proportion of the land used for the production of grain rents for cash. Many irregular-shaped tracts suited only for pasture are rented for a lump sum. Bottom-land pasture generally has the highest rental value. On some farms the renter is allowed the use of the pasture land without charge.

The 1930 Federal census reports the average value of land and buildings as $158.64 an acre. By January 1, 1935, the value of land and buildings had dropped to $99.89 an acre. The selling price of individual farms ranges widely, depending on the general economic conditions, the character of the soil, surface features, drainage, improvements, and location with respect to markets.

Most of the crops produced are used in connection with the raising and fattening of livestock. The wheat and some of the corn are grown to be sold for cash. Truck and fruit crops not needed for consumption at home are sold, but the greater part of the cultivable land is used to produce feed for cattle and hogs, which are the chief sources of revenue. Most of the feed is used on the farms where grown or is sold to cattle and hog feeders within the county.

A part of the cattle to be fattened are raised locally, but most of them are purchased when 2 or 3 years old, mainly from the Omaha markets. They are fed corn and alfalfa for a period ranging from 60 to 90 days and are then sold. Many feeders fatten from one to three carloads of cattle each year, and a few fatten calves for sale as baby beef. The beef calves, when weaned, usually are fed oats, and later corn and alfalfa. They are sold when between 14 and 18 months old. The native cattle are chiefly of grade Hereford or Shorthorn breeding.

On most of the farms from 5 to 10 milk cows are kept. A few farms in the northeastern part of the county, near Omaha, are devoted exclusively to dairying. According to the Federal census, dairy products, excluding those used for home consumption, were produced to the value of $359,088 in 1929. Except on the strictly dairy farms, where most of the milk cows are purebred Holstein-Friesians, the dairy cattle are of mixed beef and dairy breeding. Rural routes, along which the cream is collected by the purchaser, are established over much of the county, and a cream station is maintained in each town.

Most of the farmers raise from 20 to 30 hogs annually, and some have herds of 100 or more. The hogs are fed corn and alfalfa, and barley and rye frequently are added to the ration. Young pigs generally receive some oats. Many hogs are raised in connection with cattle feeding. They are all of good breeding, and there are several purebred herds of Poland China, Duroc-Jersey, and Hampshire. When ready for market, most of the hogs are trucked to Omaha.

Ordinarily, sheep raising does not receive much attention. A few farmers buy a carload or two of sheep in the fall, fatten the animals on corn and alfalfa, and sell them in Omaha when the price is most favorable.

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The raising of horses and mules has been of minor importance during recent years and is confined mainly to the breeding of the work mares. Most farmers have a colt or two for sale each year.

Chickens are raised on every farm, and many farmers have large flocks. The Federal census reports the value of poultry and eggs produced in the county during 1929 as $324,164. Most of the chickens are purebred Plymouth Rocks, White Leghorns, or Rhode Island Reds. A large number of the flocks are maintained through the purchase of baby chicks from hatcheries in Omaha. The surplus poultry products are sold or exchanged for farm supplies in the local towns.

Cropping practices in Sarpy County are similar to those in other eastern Nebraska counties. Corn, the leading crop, is planted in May either with a lister in furrows or with a corn planter in checkrows. It is cultivated at intervals of 2 or 3 weeks until early in July, after which it receives little attention until harvest. The corn matures in September or early October. Most of it is husked from the standing stalks, although some farmers cut a part of the crop for fodder and silage. Many farmers annually fence off a few acres of unhusked corn for fattening hogs and cattle. White and yellow dent varieties of corn are grown chiefly. Most of the seed is produced in the locality where it is to be planted and has become adapted to local climatic and soil conditions.

Oats are grown more extensively than any other small grain, chiefly because they fit well into rotation systems, are a good nurse crop for alfalfa, and are needed to feed work animals and young livestock. Kherson is the main variety grown. The ground is prepared by plowing and disking, and the grain is either sown broadcast or is planted with a drill in late March or early April. The crop is cut with a binder or header in July and is later threshed. The straw, which has some feed value, usually is stacked and is fed to cattle and horses. Smut sometimes reduces oat yields during prolonged periods of rainy or cloudy weather, but injury from this source can be controlled by spraying the seed the day before planting with equal parts of formaldehyde and water. One quart of solution is sufficient for treating about 40 bushels of oats.5

The wheat grown is of the winter varieties, chiefly Kanred and Nebraska No. 60. The land to be used for this crop is usually plowed and harrowed in late summer, and the seed is planted with a press drill in September. Some seed is drilled between the corn rows. Wheat usually makes a good start before heavy frosts occur, remains practically dormant during the winter, resumes growth in early spring, and matures in July. It is cut with either a binder or a combine. When cut with a binder the sheaves are either shocked or stacked for threshing. A combine cuts and threshes the crop in one operation. The yield of wheat is sometimes reduced by stinking smut, which distorts the kernels, prevents their normal growth, and gives the grain an offensive odor. This form of smut can be controlled by mixing the seed with copper sulfate powder at the rate of 2 or 3 ounces of the powder to a bushel of grain.4

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4 See footnote 5, supra.
Winter rye, chiefly of the Rosen variety, is grown for grain to be fed to hogs and to some extent for hay and temporary fall pasture. When grown for grain it is seeded and harvested in the same manner as wheat.

Barley is planted and harvested like oats. The common six-rowed smooth-bearded varieties are regarded as superior for Nebraska conditions. Practically all of the barley is used for hog feed.

Alfalfa is the leading tame hay. Only the most hardy varieties are grown, including Grimm, Common, and Cossack. Thorough seedbed preparation, including plowing, disk ing, and harrowing, is necessary before planting the seed. A stand of alfalfa generally is allowed to remain as long as it produces profitably. The crop ordinarily is cut three times during the summer on the uplands, and a fourth cutting occasionally is obtained on the bottom lands. The common practice is to stack the hay in the field and haul it to the feed lots as needed. Many farmers run hogs in the alfalfa fields during the summer.

Clover, although a minor crop, is produced in small fields on many farms. Both red clover and sweetclover are grown. Sweetclover is a biennial and dies at the end of the second year after producing seed. It occupies the larger acreage and is used chiefly for pasture although to some extent for hay and seed. Most of the red clover is used for hay. The seedbed for these crops is prepared and the seed is planted in the same manner as for alfalfa.

Wild hay is cut chiefly in areas where cultivation is difficult or impractical, as on the more poorly drained parts of the bottom lands and on some of the steeper slopes throughout the uplands. Most of the hay is stacked in the field. A part of that from the bottom lands is hauled to higher ground in order to avoid loss during flood stages of the streams.

According to the Federal census report, truck crops, exclusive of potatoes, were harvested for sale from 319 acres in 1934. Tomatoes, watermelons, cabbage, and sweet corn, ranking in acreage in the order named, are grown chiefly, although onions, radishes, and beans are produced to some extent. As previously mentioned, most of the truck crops are grown in the northeastern part of the county, near Omaha.

Practically no commercial fertilizer is used, except on some of the truck gardens where the quantity applied and the composition vary greatly. According to the Federal census, the total expenditure for both manure and commercial fertilizer amounted to only $625 in 1929. Barnyard manure is utilized by many farmers, but the supply is inadequate.

SOIL-SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field.

The soils and the underlying formations are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied at regular intervals. Each excavation exposes a series of layers, or horizons, and the entire section, from the surface down to the weathered but otherwise unmodified parent material, is known as the soil profile. The classification is based on such internal characteristics of
the soil profile as thickness, color, structure, texture, porosity, consistency, and content of organic matter, and on such external features as drainage, relief, and stoniness. The reaction of the soil and its content of lime and salts are determined by simple tests. The plant cover—either native vegetation or farm crops—is observed, and its correlation with the soils is studied. In this way the natural productivity of the soil can be determined or estimated with a fair degree of accuracy. In classifying virgin lands which may be brought under cultivation, the observation of like soils now under cultivation is an important part of the work.

On the basis of their internal and external features the soils are grouped into mapping units. The three principal units are (1) series, (2) type, and (3) phase. In places two or more of these principal units may be in such intimate or mixed pattern that they cannot be indicated clearly on a map, but must be mapped as (4), a complex. In addition there are areas of land, such as dune sand, badlands, and bare rocky mountainsides, which have no true soil and are called (5) miscellaneous land types.

The most important of these groups is the series which includes soils having the same genetic horizons, arranged alike in the soil profile, developed from similar, although not necessarily identical, kinds of parent material. Thus, the series includes soils having essentially the same color, structure, and other important internal characteristics and the same natural drainage conditions and range in relief. The texture in the upper part of the soil, including that commonly plowed, may vary within a series. The series are given geographic names taken from localities near which they were first identified. Marshall, Knox, Waukesha, Wabash, and Cass are the names of soil series in Sarpy County.

Within a soil series are one or more soil types, defined according to the texture in the upper part of the soil. The name of the soil texture, such as silt loam, silty clay loam, fine sandy loam, and loamy sand is added to the series name to give the complete name of the soil type. For example, Wabash silt loam and Wabash fine sandy loam are types within the Wabash series. Except for differences in the texture of the surface layers, these soils have the same external and internal characteristics. The soil type is the principal unit of mapping and because of its specific character is usually the unit to which agronomic data are definitely related.

A phase of a soil type is a subgroup of soils within the type, which differ from the type in some minor characteristic that may be of special practical significance. Differences in relief, degree of accelerated erosion, and content of gravel or stone are frequently the bases for phase separations. These differences may not materially influence soil character but may be of great significance in land use. For example, within the range of relief of a soil type, there may be parts that are adapted to the use of machinery and the production of cultivated crops and other parts that are not. Even though there may be no important differences in the soil itself or in its ability to produce the native vegetation throughout its distribution, there may be important

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1 The reaction of a soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality, higher values indicate alkalinity, and lower values indicate acidity.

2 The total content of readily soluble salts is determined by the use of the electrolyte bridge. Phenolphthalein solution is used to detect a strong alkaline reaction.
differences in respect to the growth of cultivated crops owing to variations in the relief. In such an instance the different kinds of relief, not normal for the soil, may be segregated on the map as either flat, sloping, or hilly phases, as the case may be. Similarly, soils having differences in stoniness may be mapped as phases even though these differences are not reflected in the character of the soil or in the growth of native plants.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, complexes, and miscellaneous land types, in relation to section and township lines, roads, houses, streams, lakes, and other cultural and natural features of the landscape.

SOILS AND CROPS

Sarpy County is in the corn- and wheat-growing belt of the United States. A diversified farming system, consisting principally of the growing of feed crops and the raising and fattening of cattle and hogs, is almost universally practiced. About 33 percent of the total land area is used for the production of corn which occupies more than three times the acreage of any other cultivated crop. About 17½ percent of the county remains in native pasture or woodland, the greater part of which is used for the grazing of cattle and the production of wild hay.

The farming and pasture lands are rather evenly distributed over the county as a whole, and most farms include a greater or smaller proportion of each, although in some rather large areas one may predominate, with the result that the farming system, although diversified, is not equally so in all localities.

As previously indicated, all the county, except places where drift or rock is exposed on the steeper valley slopes, is mantled to various depths by loess, a light-gray floury silt. This material erodes easily, and much of the land in the bluffs along the Missouri and Platte Rivers and in narrow strips along many of their tributaries is too hilly or steep for cultivation but is well suited for pasture land. Elsewhere the uplands, although rolling to hilly in most places, are not too steeply sloping for the use of farm machinery, except locally.

Nearly all of the soils are naturally productive, and prior to their use for crops the more extensive ones supported a luxuriant growth of prairie grasses. Trees grew on the bottom lands and on many of the slopes along the larger streams, but even in these localities the ground cover consisted mainly of grasses, except where the trees were unusually numerous. The annual decay of grass roots produced an abundance of black well-decomposed organic matter, which has accumulated in sufficient quantities to make the surface layers of most soils dark regardless of the color of the underlying parent material. The intensity of darkness and the depth to which the dark color has penetrated depend on relief, drainage, and length of time the soils have lain in their present positions, undisturbed by abnormal erosion.

In the more nearly level parts of the county, except those parts covered by recently deposited light-colored sediments, decomposed organic material is most abundant and has penetrated deepest into the soils. On the steeper slopes the greater part of this material was removed by the rapid run-off, the unweathered or only slightly altered substrata have been kept at or near the top of the ground, and the
soils are light-colored even at the surface. Between these topographic extremes the content and depth of penetration of the organic matter varies mainly with the degree of slope. Accumulations of organic matter have been most restricted in the bluff lands along the larger rivers, on steep valley slopes along some of the creeks and their more deeply entrenched tributaries, and in local areas of recently deposited sand on stream bottoms.

In addition to their prevailing dark color and high organic-matter content, most of the soils are characterized by a granular or crumblike structure in their upper layers, this feature persisting to a greater or less extent in all except the more sandy soils. It is best developed in the darker and more nearly mature soils of the well-drained uplands and terraces where a highly granular structure commonly extends to a depth of 2 feet or more.

A third fairly uniform characteristic of the soils is their generally low lime content. Only a few of the soils contain enough lime in their upper layers to effervescence when dilute hydrochloric acid is applied, and most of them give no lime reaction to a depth exceeding 10 feet. Nevertheless, none of the soils shows evidence of a severe deficiency of lime, except in scattered fields where applications of lime, prior to seeding, seem to promote thicker stands of alfalfa and sweetclover. Well-established stands of these crops are not notably benefited by liming the soil. An abundance of limestone outcrops within short hauling distance of most farms and can be obtained easily when the lime supply of the soil is exhausted.

The two rather persistent characteristics—high organic-matter content of the surface soil and granular or crumblike structure of the upper soil layers—are valuable soil assets for crop production. Organic matter is a strong absorbent of both heat and water. It increases the rate of moisture absorption and the moisture-holding capacity of the soil. It also promotes favorable tilth, retards water erosion, assists in maintaining temperatures favorable for growing crops, and is the chief source of nitrogen, an important plant nutrient. The granular or crumblike structure facilitates root penetration and the free movement of air and water, which changes the raw vegetal and mineral constituents of the soil into nutrients for growing crops. The lime, although nearly or entirely removed from most of the soils, has not been absent long enough in any of them to have allowed the development of a notably sour or acid condition which would hasten destruction of the organic matter and the crumblike structure.

The soils of Sarpy County are friable and easily penetrated by air, roots, and water. Nearly all of them have high moisture-holding capacity, but few are porous enough to absorb all the precipitation as rapidly as it falls, and, as a result, much of the rainfall is lost through run-off and evaporation. Over the county as a whole, probably more than 30 percent of the mean annual precipitation is lost through run-off which has considerably thinned or retarded the development of the surface soils in many places. Little of the land has been rendered uncultivable by improper farming practices, and on the smoother areas practically no injury has occurred. On many of the cultivated slopes exceeding 6 percent in gradient, however, the parent loess is exposed in numerous patches. This material, although able in itself to produce profitable yields of most farm crops, is not so
productive as the former cover of soil. The areas in which it out-
crops require careful management, including the frequent growing of
legumes or the incorporation of nitrogenous materials, if they are to
be kept highly productive.

The diversified farming system generally practiced in this county
is of considerable advantage in maintaining soil fertility. It is based
largely on livestock production and allows the farmer to rotate his
crops as desired, so long as enough feed is produced for his cattle
and hogs. He can grow considerable alfalfa, in order to replace nitro-
gen removed from the soil by grain crops, and can obtain manure from
his feed lots at no expense except that required for labor.

Each soil mapped in this county has comparatively similar use
capabilities throughout its distribution, and, except where occurring
in areas that are steeply sloping, stony, or poorly drained, returns
profitable yields of all or nearly all of the crops common to the sec-
tion. The various grain and tame-hay crops are produced to greater
or less extent on all the soils suited to cultivation, but no two soils
respond exactly alike when handled in the same manner. Even on
the same soil, the use capabilities and yields may vary somewhat from
place to place. The various responses may be due to differences, either
inherent or man-made, between the different soils or to differences
in the surface features, drainage conditions, or position of the land
with respect to higher and lower levels.

Although nearly all of the soils are used more or less extensively
for growing each of the crops, differences in the soil and moisture
conditions have determined to a large extent the proportional acreage
devoted to the various crops on the different soils and on different
slope gradients of the same soil. Corn, because of its ability to adapt
itself to a wide range of soil and moisture conditions and because it
is needed to feed livestock, is the leading crop on all the cultivated
land. The proportional acreage used for corn, however, is greater on
the well-drained parts of the Wabash, Cass, and Lamoure soils of the
bottom lands than it is on the soils of the uplands, because corn adapts
itself better to bottom-land conditions than do most of the other crops,
particularly the small grains. For a similar reason, corn occupies a
larger percentage of the rather steeply sloping land than of the more
nearly level parts of the uplands and terraces, where small-grain crops
do best and are grown most extensively.

Oats and wheat are grown chiefly on those parts of the Marshall
soils where the slopes do not exceed 7 percent. Alfalfa is grown
most extensively on the Waukesha soil of the terraces and on the
better drained parts of the bottom lands, where the moisture supply
is especially favorable. The clovers are grown mainly on hilly and
sloping areas throughout the uplands, where they are used for re-
tarding erosion and for building up the soil nitrogen supply which,
under grain farming, becomes rapidly depleted on the sloping lands.

The light-colored silty and friable soils of the Knox series are well
suited, at places, for orcharding and for grape production, especially
on northward-facing slopes that are not too steep for cultivation.
In well-drained areas, the dark Cass soils of the bottom lands are
excellent for truck crops. They warm early in the spring and are
used by many farmers for growing sweet corn, tomatoes, melons, and
cucumbers for the Omaha markets.
Although the soils differ in agricultural value, they may be placed in groups, each of which includes soils that are more nearly uniform in their use capabilities and that are used for some particular crop or crops more extensively than are soils belonging to another group. In this county four soil groups are recognized, namely: (1) Well-drained dark and deep soils of the uplands and terraces, (2) well-drained moderately dark and deep soils of the uplands, (3) excessively drained light-colored and shallow soils of the uplands, and (4) variably drained soils of the bottom lands. These groups are based mainly on drainage conditions, depth of soil material, and color as represented by humus content, which are among the most important factors affecting differences in the characteristics and agricultural value of the soils.

This method of grouping is not meant to imply that the agricultural practices are strictly uniform on the soils of any particular group or that the soils of that group are equally productive. Even within a group there is variation in the drainage conditions and other characteristics which affect agriculture, such as the surface features of the soils, their consistence, texture, stoniness, and susceptibility to erosion. In addition, the farming systems and the crops grown may vary on the different soils of a group or even on the same soil in different localities with differences in the requirements of the individual farmer and with differences in the amount and distribution of the local precipitation. Over long periods, however, the soils of each group give the largest returns when used in a manner best suited to them and their environment as a whole. In establishing the four groups recognition is given to soil and crop adaptations and to those soil characteristics that are responsible for these adaptations.

None of the soil groups is confined to any particular part of the county, and many of the soils belonging to one group are within larger areas of those belonging to another.

In the following pages the individual soils of the different groups are described, and their crop adaptations are discussed; the soil map accompanying this report shows the distribution of the soils; and table 4 gives their acreage and proportionate extent.

**Table 4.—Acreage and proportionate extent of the soils mapped in Sarpy County, Nebr.**

<table>
<thead>
<tr>
<th>Soil type</th>
<th>Acres</th>
<th>Per cent</th>
<th>Soil type</th>
<th>Acres</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marshall silty clay loam..........</td>
<td>42,432</td>
<td>27.6</td>
<td>Judson-Wabash silty loam..........</td>
<td>1,088</td>
<td>0.7</td>
</tr>
<tr>
<td>Marshall silty clay loam, smooth</td>
<td></td>
<td></td>
<td>Wabash silty clay loam...........</td>
<td>4,736</td>
<td>3.1</td>
</tr>
<tr>
<td>phase...</td>
<td>13,312</td>
<td>8.7</td>
<td>Wabash fine sandy loam...........</td>
<td>832</td>
<td>0.5</td>
</tr>
<tr>
<td>Waukusha silt loam</td>
<td>4,860</td>
<td>3.1</td>
<td>Lomoury silty clay loam..........</td>
<td>1,472</td>
<td>1.0</td>
</tr>
<tr>
<td>Marshall silty clay loam, slope</td>
<td></td>
<td></td>
<td>Cass fine sandy loam.............</td>
<td>8,384</td>
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<tr>
<td>phase...</td>
<td>20,990</td>
<td>13.0</td>
<td>Cass silty clay loam.............</td>
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<td>2.4</td>
</tr>
<tr>
<td>Carrington silty clay loam</td>
<td>448</td>
<td>0.3</td>
<td>Cass silt loam</td>
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<td>1.4</td>
</tr>
<tr>
<td>Knox silt loam</td>
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<td>24.5</td>
<td>Sarpy loamy fine sand............</td>
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<td>Knox silt loam, smooth phase...</td>
<td>6,628</td>
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<td>Riverwash.......................</td>
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<tr>
<td>Lancaster sandy loam</td>
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<td>0.3</td>
<td>Total</td>
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</tr>
<tr>
<td>Sego silt loam</td>
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</tr>
<tr>
<td>Wabash silt loam</td>
<td>19,460</td>
<td>12.6</td>
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</tr>
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</table>

**WELL-DRAINED DARK AND DEEP SOILS OF THE UPLANDS AND TERRACES**

The soils classed with this group occupy 39.4 percent of the total land area of the county. One or another of them occurs throughout
the well-drained uplands wherever erosion is not severe, and the group includes all the soils of the terraces. The relief is nearly level or rolling, few of the slopes exceed 8 percent, and external and internal drainage are everywhere adequate. The group comprises Marshall silty clay loam, its smooth phase, and Waukesha silt loam.

These soils have mellow and friable surface layers. On parts of the uplands the dark surface material has been thinned more or less by water erosion since farming began and in small patches has been nearly or entirely removed. Throughout the group as a whole, however, the surface soils are still well supplied with organic matter, are very dark grayish brown or almost black, and average thicker and darker than those of any other soils in the county, except some on the bottom lands. All have a silty texture. The subsoils are friable, allowing easy penetration of roots and free movement of air and moisture. Although these soils are very low in lime, they seem to have enough for crop needs.

All soils of this group have about equal moisture-infiltration and moisture-storing capacities, but the content of moisture differs somewhat in the different soils.

Practically all of the area occupied by these soils is under cultivation, and the main crops commonly grown are produced with good results. There are slight differences in yields on the different soils, owing more to differences in topographic features, particularly the slope of the land and its elevation with respect to surrounding areas, than to differences in the soils themselves. The Marshall soils, which are in the uplands, are more sloping than the Waukesha soils of the terraces, and they lose more of the precipitation through run-off. In addition, they are not so favorably situated as the Waukesha soils, except locally, to receive moisture from higher levels. The Marshall soils, therefore, are slightly less productive. The productivity of every soil of this group, however, exceeds that of any upland soil not belonging to the group, and the crop adaptations are wider than those of any soil of the bottom lands. Corn is grown on about 50 percent of the area occupied by these soils, oats on about 18 percent, wheat on about 15 percent, and alfalfa on about 5 percent. The rest of the land is used largely for the production of sweet clover, red clover, barley, rye, potatoes, and other minor crops.

**Marshall silty clay loam.**—Marshall silty clay loam is the most extensive soil in Sarpy County. It occupies the greater part of the gently rolling to rolling loess-covered uplands, mainly slopes ranging between 4 and 8 percent. It has good surface and internal drainage. In some places rapid run-off water has produced severe erosion, but the dark surface layer has not been thinned greatly except on the steeper slopes. The soil has high water-holding power and a fairly high infiltration capacity.

The surface soil consists of loose mellow silt loam containing an abundance of well-decayed organic matter. It is very dark grayish brown when dry and almost black when wet. Under a native-grass cover it is highly granular, but in cultivated fields the granulation has been destroyed to plow depth. In most places this layer ranges from 10 to 16 inches in thickness, depending on the degree of slope under which the soil has developed and the amount of erosion to which it has been subjected since it was brought under cultivation.
The subsoil is dark grayish brown in the upper part where stained by organic solutions from the surface soil, is brown between depths of 18 and 30 inches, and becomes light yellowish brown in the lower part. It is friable throughout, although the upper part is slightly heavier in texture than the surface soil. In most places it is faintly mottled with brown and rust-brown spots, splotches, and specks. It merges with Peorian loess, from which the soil has developed, generally within a depth of 7 feet. Neither the soil nor the upper part of the underlying loess contains sufficient lime to effervesce when dilute hydrochloric acid is applied, but crops show no evidence of a deficiency of lime.

In a few of the deeper road cuts throughout areas of this soil, widely scattered globular lime concretions, some of which are 2 inches in diameter, are observed below a depth ranging from 10 to 12 feet. These concretions are beneath the reach of all except the deepest rooted crops. The loess in which they are embedded contains no lime. Undoubtedly similar concretions occur locally throughout the distribution of the soil.

The principal variations in this soil are in the depth and texture of the surface soil which is thicker, as a rule, on the more gradual than on the steeper slopes and in the few virgin areas than in cultivated fields. The depth of the surface soil is greatest near the bases of some of the gradual slopes where soil material from higher levels has accumulated, and here the texture tends to be slightly heavier than elsewhere, approaching a silt clay in places. The soil is invariably mellow and friable, however, regardless of where it occurs.

Marshall silty clay loam is considered one of the best grain and tame-hay soils on the uplands in the prairie section, and practically all of it has been under cultivation since early settlement of the county. It is not quite so productive as its smooth phase, but this is owing more to the less even relief and consequent greater loss of moisture through run-off, compared with the phase, than to inherent differences in the two soils. As on all the cultivated soils in this county, corn occupies by far the largest acreage. Oats and wheat, however, are grown on a larger proportion of this than of any other soil on the uplands, except the smooth phase of Marshall silty clay loam. Other small grains and alfalfa occupy less than 20 percent of the land during most seasons.

All crops suited to the climate produce profitably, except in occasional years when the precipitation is very unfavorably distributed or drops far below the normal amount, when average yields are lower. During unusually wet years corn may produce from 50 to 60 bushels an acre, with yields of other crops proportionately high.

Marshall silty clay loam is easy to handle, owing to its silty stone-free character and good drainage. All the areas slope sufficiently in one direction or another to promote water erosion in cultivated fields. Nevertheless this soil can be cultivated earlier in the spring and sooner after rains than any of the more level-lying silty soils of the bottom lands or terraces. On many tenant farms this soil is used for the growing of corn 3 or more consecutive years without rotation and without sufficient care to control erosion; legumes are grown infrequently; and most of the inadequate supply of barnyard manure is applied to other soils. Even under such abuse,
the yields have not as yet declined appreciably. Obviously, however, much of the soil is being farmed in a manner that will ultimately lower its producing power, and since it occupies the greater part of most farms, any reduction in its productivity will seriously affect the farm income over the county as a whole. Proper management of this soil requires its less continuous use for cultivated crops, as frequent stirring of the soil makes it very loose and susceptible to erosion. Approximately 10 percent of the land should be used annually for the growing of legumes, which will assist in replacing the nitrogen removed by previous grain crops. Contour listing and strip cropping should be practiced where feasible, in order to impede run-off and thus conserve the moisture supply. In contour listing, however, care should be taken to maintain an adequate gradient and parallel furrows; otherwise serious gullies may result from water becoming impounded in the furrows at critical points and overflowing the lister ridges.

Basin listers, designed to leave small dams at frequent intervals in the bottoms of the lister furrows, are used by some farmers when planting corn on contours and when preparing the land in the fall to receive the winter and spring precipitation. Most types of these listers have proved helpful, during recent years, in increasing the supply of soil moisture. The advantage of the use of small dams in cornfields during wet seasons has not been determined. They impound the water most effectively during the period between planting time and the first cultivation, but on heavy soils they might cause some damage to the young corn plants. They are, of course, destroyed during cultivation.

**Marshall silty clay loam, smooth phase.**—The smooth phase of Marshall silty clay loam differs from the typical soil mainly in having more nearly even surface features. It occupies narrow, elongated, and tortuous strips on the smoother and broader tops of divides where the land is nearly level or has less than a 4-percent slope. The strips range from a few rods to about one-half mile in width and are scattered throughout nearly all parts of the loessial uplands, on some of the highest positions in the county. Although numerous, most of them are not sufficiently wide to occupy more than a small part of the farms on which they occur.

All this soil is under cultivation. The soil itself does not differ materially from that of typical Marshall silty clay loam, previously described, but owing to its smoother relief and therefore slower run-off, it absorbs a larger percentage of the precipitation than typical Marshall silty clay loam and is less subject to erosion.

The surface soil, which averages about 15 inches in thickness, is loose and mellow, well supplied with organic matter, and very dark. The rest of the soil gradually becomes lighter in color with depth, remains friable, and merges with the parent Peorian loess at a depth of about 7 feet. Neither the soil nor the upper part of the parent material is limy. The soil is remarkably uniform in profile features throughout its distribution.

The smooth phase of Marshall silty clay loam is the most productive and easily managed soil of the uplands. It is not, however, greatly superior to the more rolling Marshall soil in any of its properties and owing to its rather small extent is much less impor-
tant agriculturally than that soil. The same crops are grown on it as on typical Marshall silty clay loam and it is managed in about the same manner as that soil. Corn occupies the leading acreage, but a larger percentage of this smooth soil is used for the growing of small grains and alfalfa than is similarly used of any other soil of the uplands.

**Waukesha silt loam.**—Waukesha silt loam covers the stream terraces or benches and comprises a total area of 7.5 square miles in this county. It has developed mainly from loess or loesslike material and occupies several different terrace levels, all which are well above danger of overflow from the main streams.

The terraces have nearly flat or very gently undulating relief except where crossed by drainageways issuing from the uplands. The oldest and highest terrace is in the vicinity of Fort Crook. This and a few of the other high benches were capped by loess, as were the uplands, and only their basal parts are water-laid. The material composing the lower terraces is strictly alluvial, having been carried to its present positions by the streams and deposited upon their flood plains when they were flowing at higher levels.

All areas of the Waukesha soil have good surface and internal drainage, and practically none of the land is subject to damaging erosion. This soil does not differ materially in profile features from Marshall silt loam of the uplands.

The surface soil is very dark grayish brown when dry, almost black when wet, and consists of loose mellow silt loam with a high organic-matter content. It extends to an average depth of about 14 inches and is highly granular except in the 4- or 5-inch surface layer where tillage has destroyed the granulation. The upper subsoil layer is composed of brown or dark-brown granular silt loam or silty clay loam, slightly heavier than the surface soil but friable throughout. This gradually gives way, at a depth ranging from 20 to 30 inches, to light-brown or brownish-yellow mellow silt loam which rests on floury light-gray parent silt a little below a depth of 4 feet. Neither the soil nor the upper part of its parent material is limy.

Included with Waukesha silt loam are a few small patches which would be mapped as Judson silt loam and Waukesha fine sandy loam, had their size warranted the separation. The Judson soil represents the accumulation, at the base of slopes leading to the uplands or from the bottoms to the terraces, of a layer exceeding 3 feet of black surface soil material washed or rolled down from the higher levels. Waukesha fine sandy loam differs from Waukesha silt loam only in having a larger percentage of fine sand and very fine sand in the upper 6- to 10-inch layer of the surface soil. These included soils do not differ greatly in agricultural value from typical Waukesha silt loam.

This soil is under cultivation, except in inaccessible strips and bodies along some of the narrower valleys where the terraces are severely dissected by stream meanders and are included in pasture land. It is admirably suited to all the crops commonly grown and is considered the best general-farming soil of the section. Corn, oats, and alfalfa, ranking in acreage during most years in the order named, are the principal crops. Wheat is of minor importance but is pro-
duced on a larger percentage of this than of any other soil in the county.

All crops yield higher on Waukesha silt loam than on the best soil of the uplands, chiefly because of the increased moisture supply on the terraces. Alfalfa can be grown more frequently than on the upland soils without depleting the deep-seated moisture supply so essential for the continued production of alfalfa in Nebraska.

WELL-DRAINED MODERATELY DARK AND DEEP SOILS OF THE UPLANDS

The soils of this group either did not develop so deeply as those of the group previously described or were more thinned by erosion subsequent to development. They occupy slopes, most of which range from 8 to 15 percent. Carrington silt clay loam and the slope phase of Marshall silt clay loam comprise the group.

These soils occupy 13.3 percent of the area of the county. Almost all the land is cultivated and is used for the same crops as those grown on the deeper and darker soils of the uplands. On the whole, yields are only slightly less than on those soils. Much moisture is lost through run-off, because of the steepness of the slopes and, in places, because of the relative imperviousness of the soil material as well. Most of the cultivated fields include patches from which the surface soil has been removed, and in places the parent material is exposed.

The heavier types of farm machinery are used with difficulty on many of the steeper slopes, and more labor is required to control erosion and to conserve moisture and plant nutrients than is required on the darker and deeper soils of the uplands and terraces. For the most part, however, the soils are well suited for growing corn and clover, which occupy a larger percentage of these soils than they do of the soils of any other group, except the group that includes the soils of the bottom lands.

Marshall silty clay loam, slope phase.—The slope phase of Marshall silty clay loam includes strongly rolling and rather steeply sloping areas of Marshall silty clay loam. The greater part of this soil occupies rather narrow strips on valley sides where the slopes range from 7 to 15 percent. Surface run-off is everywhere moderately to extremely rapid, and the land, as a whole, has suffered considerable erosion.

The surface soil is loose and mellow. It consists of silt loam in most places, but it contains enough clay in patches to give it a silty clay loam texture. It varies in thickness and color. On the more gradual slopes it has accumulated considerable organic matter, is very dark grayish brown, and is from 8 to 12 inches thick. On the steeper slopes it exceeds 8 inches in thickness in only a few places and is nowhere so dark as in the areas of less relief. In numerous areas, too small to indicate legibly on the accompanying map, the surface soil has been removed, and either the subsoil or the parent loess is exposed. The subsoil is identical in color, consistence, and texture to that of the typical soil which occupies the less steeply sloping parts of the uplands, but it averages thinner. It rests on the parent Peorian loess, in most places at a depth of about 3 feet. Except in a few localities, neither the soil nor the upper part of the underlying loess is calcareous.
Most of the land occupied by this soil is under cultivation and practically none of it is too steeply sloping for farming if carefully managed. The heavier types of machinery, however, are handled with difficulty on the steeper slopes. All the cultivated land is used for growing the same crops as are produced on typical Marshall silty clay loam or its smooth phase. Corn occupies by far the largest acreage. In the past, corn has been grown mainly in straight rows regardless of the lay of the land. The tendency during recent years has been to reduce the acreage in corn on this soil, to confine the crop mainly to the more gradual slopes, and to plant more of it on the contour, also to increase the acreage of alfalfa, sweetclover, and red clover. Small-grain crops have never been grown extensively on the sloping lands.

This soil is productive and probably is in no immediate danger of becoming exhausted to the point where the present cultivated crops will not yield profitably. Its productivity could be considerably increased, however, by practices designed to retard run-off on the slopes and thus allow more of the moisture to be absorbed. The growing of more leguminous crops would also increase the yields, especially of corn.

**Carrington silty clay loam.**—Carrington silty clay loam is mapped in this county wherever erosion has removed the loess mantle and exposed the underlying glacial drift to weathering and soil development. It occupies a few narrow and discontinuous strips near the bases of slopes bordering the more deeply entrenched drainageways and here and there extends over low divides. None of the strips occupies more than 80 acres. The largest area is north of Richfield on a tributary of Papillion Creek.

Most areas of this soil slope rather steeply in one direction or another. In places the slopes do not exceed 6 percent; but the soil and parent drift have rather low infiltration rates, and run-off is rapid and erosion severe wherever the native grasses have been destroyed.

Practically none of this soil is as deeply developed in this county as is characteristic of typical Carrington silty clay loam elsewhere. In most places, however, it has accumulated more organic matter and is deeper than the Shelby soils, which represent the first stages of soil development on glacial drift.

The surface soil, except where erosion has been unusually severe, consists of very dark grayish-brown friable and granular silt loam or loam, ranging from 7 to 10 inches in thickness. The upper part of the subsoil is dark-brown silt loam or sandy clay loam, which is somewhat heavier than the surface soil but remains fairly friable and is easily penetrated by plant roots. It absorbs water rather slowly. This layer extends to a depth of about 2 feet. The lower subsoil layer consists of light-brown or grayish-yellow moderately heavy sandy clay containing in places numerous rust-brown streaks, splotches, and spots. It merges with the weathered but otherwise little modified glacial drift, generally within a depth of 4 feet. This, the parent material, is a brown heterogeneous mixture of sand, silt, clay, and gravel, containing a few boulders in some localities. Scattered gravel are on the surface of the ground and in all soil horizons.
Included in mapped areas of this soil are numerous patches in which erosion has removed the soil or has prevented its development, and the raw drift is exposed. Small exposed patches of Loveland loess also are included. This material is a pale-red rather sandy silt which lies between the Peorian loess and the drift in certain localities. It is an older and more oxidized loess than the Peorian.

Where best developed, as on the more gradual slopes, Carrington silty clay loam contains no lime to a depth exceeding 10 feet. In most of the severely eroded patches, however, the drift is limy to or nearly to the surface of the ground and contains thin seams of almost pure calcium carbonate.

Owing to its small extent, rather slow moisture-absorbing rate, and susceptibility to erosion, this soil is of little agricultural importance in Sarpy County. About 50 percent of it, including the more gently sloping areas, is under cultivation, and the rest remains in pasture and woodland. The cultivated areas are used for growing all crops common to the section. In this county the yields obtained are somewhat lower than those produced on most loess-derived soils of the uplands; but in counties where typically developed, Carrington silty clay loam is almost as productive as Marshall silty clay loam. Its chief requirement is careful management designed to retard erosion and conserve moisture.

EXCESSIVELY DRAINED LIGHT-COLORED AND SHALLOW SOILS OF THE UPLANDS

The soils of this group have been subjected to such severe erosion either during or subsequent to their development that they have been unable to accumulate much organic matter. They occur chiefly on steep valley sides, exceeding 15 percent gradient, in the bluff-land strip along the Missouri and Platte Rivers around the eastern and southern sides of the county. They also occur less extensively on steep slopes along many of the drainageways tributary to these streams and on the sharper hilltops and narrower ridges throughout all parts of the county.

The group includes the Knox, Lancaster, and Sogn soils which collectively occupy 16.4 percent of the total area of the county. The Knox soils consist almost entirely of light-gray silty and floury loess. In most virgin areas their immediate surface layers are darkened considerably by organic matter, but in few places do the dark layers exceed a thickness of 6 inches. The Lancaster and Sogn soils occupy steep to precipitous slopes, where the former are developing from Dakota sandstones and the latter from limestones and light-colored calcareous shales. These soils are of small extent. Most areas of them consist mainly of exposures of bedrock.

The greater part of the area occupied by the soils of this group is too steeply sloping for farming and remains in native pasture or woodland. Nearly all of the Knox soil areas, on which it is possible to use tillage machinery, however, are under cultivation. Throughout the greater part of these areas the former surface soil has long since been removed by erosion, and, in most places, the unweathered or only slightly weathered loess is exposed. The cultivated land is used chiefly for growing corn and to less extent for growing sweetclover and red clover. The loess is fairly productive in itself, and, except in the drier years when crops may fail, rather low but profitable yields are
obtained even without manuring the land. Under careful management, including the incorporation of manure and the frequent growing of legumes, the loess is highly productive in seasons of normal or above normal precipitation. The land is best suited for the production of clover and for orchards.

**Knox silt loam.**—Knox silt loam has the most steeply sloping and hilly relief and is the most severely eroded and lightest colored soil of the loessial uplands. It occurs principally around the eastern, southern, and western sides of the county where deeply entrenched tributaries to the Missouri and Platte Rivers have carved the thick loess mantle into an extremely rough and hilly terrain. There are also numerous areas on the steeper slopes and sharper ridge crests throughout the interior of the county. The smaller developments, ranging in size from a few square rods to an acre or two, are not shown separately on the soil map.

This soil has been subjected to such continual erosion that the products of soil development are removed almost as fast as they form, and the unweathered or only partly weathered loess is kept at or near the surface of the ground. The surface soil, where developed enough to be classed as such, in few places is darker than light brown, and little of it exceeds 6 inches in thickness. It consists of loose floury silt loam. The rest of the soil mass is brownish-yellow silt loam of about the same consistence as the surface soil. It merges downward into the raw yellowish-white or brownish-white silt of the parent Peorian loess, in most places within a depth of 2 feet. Even in areas where the soil is best developed, the loess is exposed in numerous places, and many of the areas have practically no soil over the loess.

The content of lime differs considerably from place to place. In the bluff-land strip along the rivers where the soil is developing mainly on the deeper loess strata, it is ordinarily very calcareous from the surface downward, but in many of the smaller areas throughout the interior of the county, it is either low in lime or is lime free. Apparently the upper strata in the loess, of which the soil so largely consists, have been leached of most of their lime.

Much of this soil in the bluff lands formerly was forested. The chief growth on the upper slopes and crests of hills was hazel brush, bur oak, and sumac, and on the lower slopes, elm, black oak, red oak, hickory, basswood, ash, and boxelder. Many of the forested areas have been cleared, although at least 30 percent of the soil near the rivers still supports trees. Except in the bluff lands, most of the soil developed under prairie grasses, and the surface soil, although thin, was formerly very dark. It has attained its present light color largely through erosion since farming began.

About 30 percent of the soil including nearly all areas that are not too steeply sloping or hilly for the use of farm machinery are under cultivation. Corn and oats are grown chiefly, although a considerable proportion of the land is used for the production of alfalfa, sweetclover, and red clover. The plant nutrients are supplied mainly, and in some areas probably entirely, by the loess alone. Average yields of grain are considerably lower than those obtained on soils having deep dark surface layers, but alfalfa and the clovers do nearly as well as on the darker soils of the uplands. On farms where the leguminous and grain crops are consistently rotated, both
return high yields, except in unusually dry seasons when all the soils on the uplands produce rather low yields.

Areas of this soil which are too steeply sloping for farming remain with their native cover of grasses or trees and are included in pastures and woodland.

Although the farmed areas have suffered more severely from erosion than they would have done under their former cover of trees and grass, they give larger returns, during normal years, than could be obtained from native pasture or woodland. This situation probably will continue until the loess formation has eroded and the underlying relatively unproductive drift is exposed. As the loess is very thick, the areas will not decrease in productivity for many years, provided sufficient care is taken to prevent gullying—the only form of erosion that can injure the land for cultivated crops. The productivity of this soil can be greatly increased by retaining the rainfall longer on the slopes, by applications of barnyard manure, and by growing leguminous crops more frequently.

**Knox silt loam, smooth phase.**—The smooth phase of Knox silt loam differs from the typical soil only in having more nearly even surface features. It occupies elongated and generally narrow areas on the more rounded hilltops and ridges where the slope ordinarily does not exceed 7 percent and where farm machinery can be used with little difficulty. In these areas all or nearly all of the soil material has been removed by erosion, and the unaltered or only slightly altered loess is exposed, but, owing to the less steeply sloping relief, run-off is not so rapid as on the hill and valley sides, and more of it penetrates the ground. All crops common to the section are grown on this smooth soil. Slightly higher yields are obtained than on the more sloping Knox soil. As in all Knox soils, organic matter and, consequently, nitrogen are deficient, and the productivity is less than in the darker loess-derived soils of the uplands. The productivity can be greatly improved, however, by the same measures recommended for the more steeply sloping areas of Knox silt loam.

**Lancaster sandy loam.**—Lancaster sandy loam is of very small extent. It occurs only in places where erosion has removed the loess and drift mantle rocks and has exposed the Dakota formation to weathering and soil development. This formation, a reddish-brown loosely indurated sandstone, weathers slowly and has not furnished much material for soil. All areas mapped as Lancaster sandy loam in Sarpy County include numerous outcrops of the raw sandstone.

This soil occupies the lower slopes of deeply entrenched drainage ways. Nearly all of it is in the bluff-land strip along the Missouri and Platte Rivers, where the areas are few, small, and widely scattered. Most of it is so severely eroded, rough, and broken that it cannot be cultivated.

Where best developed, as in a few small patches of rather gradually sloping land, the surface soil has accumulated considerable organic matter and is very dark grayish-brown friable loam, ranging from 8 to 12 inches in thickness. The upper part of the subsoil is dark brown and slightly heavier than the surface soil but is friable throughout. The rest of the soil mass consists of loose rust-brown or yellowish-brown sandy loam which rests on
the parent Dakota sandstone, generally within a depth of 30 inches. The entire soil mass is lime free. In most places, however, the soil does not attain the thickness of the profile described and bedrock lies within a depth of 15 inches. For the most part, this soil is very immature and low in organic matter.

Where not too shallow and steeply sloping for cultivation, Lancaster sandy loam is well suited for growing all crops common to the section. It absorbs water rapidly and, owing to its generally sandy character, warms earlier in the spring than most of the other soils on the uplands. Some of it is used for growing truck crops, but the greater part remains with its native cover of grass or forest and is included in pasture and woodland.

**Sogn silt loam.**—Sogn silt loam is a very shallow soil developing on limestones and limy shales, under conditions of severe erosion. It occupies a few small scattered tracts on the lower parts of steep slopes bordering deep drainageways in the bluff lands along the Missouri and Platte Rivers. Its total area in this county is small.

In places where this soil is best developed, its 4-inch surface soil consists of almost black mellow silt loam. This material rests directly on the weathered and disintegrating surface of the parent limestone or shale, fragments of which are thickly scattered over the ground. In most of the areas erosion has been so severe and bedrock is so near the surface that little or no soil has developed.

Owing to its small extent and shallow stony character, practically all of this soil is included in pastures and woodland. The cover of prairie grasses is thick, except where the trees—chiefly bur oaks—are closely spaced and do not allow enough sunlight to penetrate. The trees are not of merchantable size but are suitable for fence posts and fuel.

**VARIABLY DRAINED SOILS OF THE BOTTOM LANDS**

The soils of this group occupy 30.9 percent of the total area of the county. They occur in bodies and strips of various sizes on the bottom lands or flood plains along all the larger and many of the smaller streams. They overlie rather recently deposited stream sediments and are most extensively developed along the Platte and Missouri Rivers and Big Papillion Creek.

The surface of the bottom lands is remarkably smooth, except where traversed by drainage channels or where modified by slight elevations and shallow depressions. Surface drainage, although rather slow, is well established, except in a few places. Most of the land lies from 3 to 8 feet above the present stream beds and is subject to occasional overflow, but the water usually drains off within a short time, except in a few of the shallow depressions, where it disappears slowly through seepage and evaporation. Practically all of the formerly poorly drained areas, in which the soils are suitable for farming, have been ditched or tiled. Along the rivers the water table is at a depth ranging from 4 to 15 feet beneath the surface, and the subsoils are well supplied with moisture, even in the drier years.

This group includes the Wabash, Judson-Wabash, Lamoure, Cass, and Sarpy soils, and riverwash.
None of these soils is old enough to have become modified greatly by soil-developing processes, and subsoil horizons, such as occur in most soils of the uplands, have not yet formed. The composition of the sediments on which the soils of this group are developing is the dominant factor in determining the character of the soils. Those sediments deposited by the local streams flowing through loessial uplands are naturally uniform and silty in texture; and those laid down by the more deeply entrenched streams, which have cut through the loess into the underlying drift and bedrock formations, are coarser and more variable in texture. The mixing and reassorting of the fine and coarse particles have produced a varied assortment of sediments along the Platte and Missouri Rivers where materials originated not only from the local loessial uplands but also from sections outside the county, chiefly to the north and west. The Wabash and Lamoure soils are developing on the finer textured sediments, chiefly silt and clays, whereas the Cass and Sarpy soils are developing on the sands and gravels. Riverwash is composed dominantly of sand.

All soils of this group are naturally better supplied with moisture than soils of the uplands and terraces because they receive not only the precipitation but also considerable moisture through run-off from higher levels and through capillarity from the underlying water table. The moist condition prevailing in the bottom lands favors luxuriant growth of plants, chiefly grasses, and rapid decay of vegetation. All except the Sarpy soils and riverwash, which are the most recently deposited sands, have very dark surface layers, owing to an abundance of organic matter.

More than one-half of the area occupied by the soils of this group is used for the production of grain and tame hay. The cultivable areas are best suited for growing corn and alfalfa, and they produce higher average yields of these crops than can be obtained on any soil of the uplands or terraces. Small grains grow well on the bottom lands, but, owing to the abundant supply of organic matter and moisture, they generally make a rank vegetal growth, at the expense of the grain, and mature rather late.

The uncultivated soils of the group are for the most part in woodland or in narrow strips severely dissected by stream meanders along the smaller drainageways. The greater parts of them support a luxuriant growth of grass, together with some trees, and are used chiefly for pasture land.

**Wabash silt loam.**—Wabash silt loam is the most extensive soil on the bottom lands or flood plains. It occupies strips of various widths along all the larger and most of the smaller drainageways. The widest strips border Papillion and Big Papillion Creeks. The total area of this soil in Sarpy County is 30.4 square miles.

The relief in areas of Wabash silt loam is nearly flat, although the slope down the valleys is sufficient in most places to afford ample surface drainage. The soil lies only a few feet above the stream channels and is subject to occasional overflow, but water drains off rapidly when the streams subside, except in some of the depressions, most of which have been ditched or tiled.

This soil has an abundance of organic matter. It is developing on dark material washed mainly from the surface layers of soils on valley sides farther upstream and carried to its present position as sediment. The 15- to 18-inch surface soil is almost black, even when dry. It has
a silt loam texture and is mellow and friable throughout. The rest of the soil material consists of moderately compact silty clay loam to a depth of several feet. It is well supplied with organic matter and is almost as dark as the surface soil. No part of the soil mass contains sufficient lime to produce noticeable effervescence when hydrochloric acid is applied, but crops indicate no deficiency of lime.

Wabash silt loam is considered more productive of corn and alfalfa than any other soil in Nebraska and is used mainly for growing these crops. Although moderately heavy in the lower part, it has no gumbo-like characteristics and is readily penetrated by air, roots, and moisture. The soil is easily managed and is not subject to injurious erosion. It can be plowed under a fairly wide range of moisture conditions considering its silty texture, but, if stirred when wet, hard lumps are formed, that require subsequent wetting and drying or freezing and thawing before favorable tilth is restored.

All the small-grain crops common to the section can be grown on this soil, but generally the abundant supply of moisture and organic matter has a tendency to make these crops mature rather late and produce long weak stems and abnormal vegetal growth at the expense of the grain.

About 90 percent of the soil, including all the readily accessible areas, is under cultivation. The only remaining pasture land is along some of the smaller drainageways where the bottom lands have been severely dissected by stream meanders. Most of these areas support a considerable growth of trees which are of value for posts and fuel.

**Judson-Wabash silt loam.**—Strips of mixed Judson and Wabash silt loams occur along narrow and intermittently flowing drainageways where the soil is developing on locally derived colluvium or alluvium that has washed, rolled, or blown from adjoining higher land. Few of the strips exceed 20 rods in width, and most of them are only 2 or 3 rods wide. They lie nearly level for a few feet on each side of the drainage channel but extend for short distances up the valley sides where, in places, the land may have as much as a 5-percent gradient. The soil is everywhere well drained but is not subject to injurious erosion. It has a small total area in this county.

This soil is low but not deficient in lime. Organic matter is abundant and in most places imparts a nearly black color to the soil to a depth of 3 feet or more. The topmost 12- to 16-inch layer consists of loose mellow silt loam. The rest of the soil material is moderately heavy silty clay loam, as a rule, but in a few places it does not differ significantly from the surface soil in color, texture, or consistence. The dark material is deepest near the drainage channels and gradually becomes shallower up the valley sides over the underlying somewhat brown drift or light-gray loess.

Nearly all areas of this soil are farmed, except the parts occupied by drainage channels or a forest cover. The same crops, chiefly corn and alfalfa, are grown as on Wabash silt loam, although a larger proportion of Judson-Wabash silt loam is used for producing small grains which, owing to a less abundant supply of soil moisture, do not grow so rank or mature so late as on typical Wabash silt loam.

This soil is as productive of all crops commonly grown in eastern Nebraska as is any soil of this section, but in Sarpy County it is of little agricultural importance on account of its small extent.
Wabash silty clay loam.—Wabash silty clay loam differs from Wabash silt loam mainly in having a more clayey and heavier surface soil. Most of it lies a little below the general level of the other soils on the bottom lands along the Missouri and Platte Rivers. The largest development is on the bottoms near the mouth of Papillion Creek.

All areas of Wabash silty clay loam are nearly flat. They lie only a few feet above the normal level of the streams and are subject to overflow during periods of high water. Few of them remain inundated after the streams subside, and most of the soil is sufficiently well drained for the production of crops. Some of the areas have been ditched or tiled in order to afford better drainage.

In common with all the Wabash soils, this soil has accumulated an abundance of organic matter and is everywhere very dark to a depth of several feet. The surface soil consists of almost black heavy silty clay loam ranging from 10 to 15 inches in thickness. It rests on slightly heavier material consisting largely of clay which is almost as dark as the overlying layer but includes a few rust-brown spots, splottes, and streaks caused by imperfect drainage. This layer extends downward for 3 or more feet, generally with little change. In a few places seams of material having slight variations in texture and color occur within the soil areas, owing to changes in the position or rapidity of the stream or to the source of the sediments that were deposited. None of the soil material shows a noticeable content of lime when acid is applied, but crops do not suffer from a deficiency of lime.

Included with areas of this soil as mapped are a few poorly drained patches of Wabash clay. These occur chiefly in unusually low narrow depressions in overflow channels where almost pure clay has been deposited. The deposits support a very rank growth of coarse vegetation and have accumulated so much organic matter that they resemble muck in places. They are not sufficiently extensive to warrant separate recognition on the soil map.

Wabash silty clay loam, where adequately drained, is as productive as Wabash silt loam but is more difficult to handle. It cannot be farmed under as wide a range of moisture conditions as can Wabash silt loam, and it remains wet and intractable later in the spring and longer after rainy periods. If plowed when wet it puddles and bakes, and it can hardly be tilled when extremely dry, as, during periods of drought, it shrinks considerably, forming cracks which break some of the plant roots and promote further desiccation. This soil is inherently as strong and productive as Wabash silt loam and under favorable moisture conditions can be kept in good tilth easily. About 70 percent of it, including nearly all areas having good natural drainage and those which have been ditched or tiled, is under cultivation. Corn and alfalfa are grown chiefly, in the proportion of about 15 acres of corn to 1 of alfalfa. Practically no small grain is grown. The uncultivated areas and nearly all of the included areas of Wabash clay are used for pasture and woodland, for which they are well suited.

Wabash fine sandy loam.—Wabash fine sandy loam differs from Wabash silt loam only in having more sand in its surface layer, which averages a fine sandy loam in texture to a depth ranging from 8 to 15 inches. The soil is well supplied with organic matter,
is almost black to a depth below 3 feet, has a moderately heavy silty clay loam subsoil, and is very low but not deficient in lime. It is nearly flat, with its surface only a few feet above the normal level of the streams, and is subject to occasional overflow, but the water drains off rapidly, and practically none of the land is too poorly drained for cultivation.

The sand content of the surface layer slightly increases the moisture-absorbing rate but is not sufficient to noticeably impair the stability of the surface soil or to promote drifting during periods of dry windy weather. It does not reduce crop yields, and the soil has about the same producing capacity as has Wabash silt loam, but it can be cultivated sooner after heavy rains without injuring its tilth and with less power. Practically all of the land is used for the production of corn and alfalfa.

Although very productive, this soil is very inextensive in Sarpy County and is of only local agricultural importance. One of the largest bodies, comprising about 200 acres, is on the Platte River bottoms 2 miles west of La Platte. Two slightly smaller areas are on the Missouri River bottoms northeast of this town. The other bodies are much smaller.

Lamoure silty clay loam.—Lamoure silty clay loam differs from Wabash silty clay loam only in having a wider color range in its subsoil and a much higher lime content. It occurs on the flat bottom lands of the Platte River, chiefly in the western part of the county. The largest development, comprising about 800 acres, is in a long strip from one-fourth to one-half mile wide, east of the mouth of the Elkhorn River. A slightly smaller area is northeast of Linoma Beach. Throughout most of its distribution, this soil lies a little below the more silty or sandy soils of the bottom lands and is not quite so well drained. It is subject to overflow from the main streams during periods of high water, but in most places drainage is sufficient for cultivation, except in unusually wet years.

The surface layer, consisting of nearly black rather heavy silty clay loam with an abundance of organic matter, ranges from 10 to 15 inches in thickness. Below this is clay or heavy silty clay, which ranges from gray to almost black but in most places is variegated gray and dark brown, with numerous rust-brown specks, splotches, and spots. It is very limy below an average depth of 20 inches.

Where adequately drained, Lamoure silty clay loam is as productive of corn and alfalfa as is Wabash silt loam, and it is used mainly for growing these crops. It cannot be cultivated satisfactorily under a very wide range of moisture conditions and is not so easily managed as the less clayey soils of the bottom lands. When plowed while wet, it has a tendency to form clods which do not break down readily. The more poorly drained patches of this soil are included in woodland and farm pastures.

Cass fine sandy loam.—Cass fine sandy loam occupies 13.1 square miles in this county. It occurs in numerous strips and various-sized irregular-shaped areas on the bottom lands of the Missouri, Platte, and Elkhorn Rivers. The areas are nearly flat or very gently undulating except where modified by low hummocks and small shallow depressions or where crossed by stream channels. All the land is overflowed during flood periods, but none remains inundated after
the streams subside. In general, the soil has ample drainage, owing to its porosity.

In common with nearly all of the soils of the bottom lands, Cass fine sandy loam has accumulated an abundance of well-decayed plant material. The surface soil, which ranges in thickness from 8 to 14 inches, is dark grayish brown or very dark grayish brown in most places, but in numerous localities it is almost black, especially when wet. It consists largely of fine and medium grades of sand but contains enough silt and organic matter to make it a fine sandy loam or sandy loam.

Beneath the surface soil the material becomes rapidly lighter in color, looser, and more sandy. It grades downward into gray incoherent almost pure fine sand or medium sand within a depth of 2 feet. Coarse sand and gravel are present below a depth of 3 feet, in places, and the lower part of the soil ordinarily contains scattered rust-brown spots caused by imperfect drainage. No lime occurs in any part of the soil mass, but the vegetation does not indicate a deficiency of lime.

This soil is not quite so productive as is Wabash silt loam, owing probably to the higher sand and lower organic-matter content of its subsoil. It can be cultivated under almost any moisture conditions without injury and warms earlier in the spring than any of the finer textured soils. About 70 percent of it is used for the growing of corn and alfalfa, both of which yield well even during seasons of prolonged drought. The soil responds favorably to applications of manure and is one of the best soils in Nebraska for the production of truck crops. Several small truck farms are located on it in the Missouri River bottoms, where garden vegetables, watermelons, and cantaloupes are produced for the Omaha market.

The uncultivated areas of this soil are in pastures, wild-hay meadows, or woodland. They include a few poorly drained tracts and numerous areas which either support a forest growth or are so inaccessible, owing to stream meanders and overflow channels, that it is not practical to farm them.

**Cass silty clay loam.**—Cass silty clay loam is less extensive than the fine sandy loam with which it is associated chiefly on the Platte River bottoms. One of the largest areas is north of Linoma Beach.

This soil lies a little below the general level of Cass fine sandy loam and has poorer natural drainage. Most of the areas, formerly too wet for cultivation, have been ditched or tiled, and all the land is now adequately drained, except during seasons of unusually high precipitation.

The last sedimentary deposits in areas of Cass silty clay loam were composed largely of clay, and the upper soil layers are heavy. The 8- or 10-inch surface soil consists of very dark gray or almost black heavy silty clay loam which is sticky and plastic when wet and becomes hard and brittle on drying. This layer is almost identical with the corresponding layer of Wabash silty clay loam. It is underlain by an 8- to 15-inch layer of material similar in texture and consistence to that in the layer above but containing less organic matter. This material is gray and contains numerous rust-brown and brown mottlings. Beneath it is light-gray fine sandy loam or sandy loam, which grades downward into almost pure sand within a depth of 3 feet. The entire soil is lime free.
 Practically all of this soil is used for the production of corn and alfalfa. It is nearly as productive as Wabash silt loam but, owing to the heavy nature of its surface soil, is more difficult to handle, and heavy farm equipment is required for thorough tillage. In common with nearly all of the soils of the bottom lands, Cass silty clay loam can be used for growing the same crop several years in succession without serious decrease in yields, because its supply of nutrients is replenished, to a certain extent, through additional sediments during periods of overflow. It gives higher average yields of corn if the crop is systematically rotated with alfalfa or some other legume. A few small areas of this soil, which are too wet for cultivation or are rather inaccessible on account of overflow channels, remain in pastures or woodland.

 Cass silt loam.—Cass silt loam is one of the less extensive soils in Sarpy County. It occurs in numerous but small areas, mostly in the Platte River bottom lands, although some are in the Missouri River and Elkhorn River bottoms. One of the largest developments, comprising about 320 acres, is near the Elkhorn River about 2¼ miles northwest of Gretna.

 The relief in areas of this soil is nearly flat, and there are a few meandering sloughs. Owing to the underlying light-textured material, the soil as a whole is well drained. Most of it lies a trifle higher than Cass silty clay loam, although none of it is above overflow during stages of high water.

 The surface soil consists of friable very dark grayish-brown or nearly black silt loam, 8 or 10 inches thick. The next lower layer is equally friable but is slightly lighter in color, being dark grayish-brown very fine sandy loam which extends to a depth of about 18 inches. The rest of the soil material is incoherent gray sand in most places, but in many localities it contains enough silt or clay to make it slightly coherent. It includes numerous rust-brown splotches and spots caused by imperfect drainage. The soil does not contain sufficient lime to produce visible reaction when hydrochloric acid is applied.

 This soil, except that in narrow strips along some of the overflow channels and in a few poorly drained depressions, is used mainly for the growing of corn and alfalfa. It works easily and can be tilled under a rather wide range of moisture conditions considering the silty nature of its surface soil. Clods form if the land is plowed when wet, but they reduce easily, and favorable tilth is maintained with less difficulty than on Cass silty clay loam and Wabash silty clay loam.

 Sarpy loamy fine sand.—Sarpy loamy fine sand occurs in numerous, but mostly small, areas and narrow strips on the bottom lands along the Platte, Elkhorn, and Missouri Rivers. The principal developments are those near the junction of the Platte and Missouri Rivers, northwest of Linoma Beach, and between the Platte and Elkhorn Rivers.

 Most areas of this soil are flat, but they may be modified, in places, by old cut-offs and depressions and by slight elevations formed by the wind which, in the more exposed areas, whips the loose sand into low rounded knolls and ridges. The soil lies slightly higher than areas of riverwash and is subject to inundation during periods of high water, but overflows do little damage as the land is seldom used
for the production of cultivated crops. The soil, as a whole, is well drained, but in wet years the underlying water table is very near the surface, and in the lower areas marshy conditions sometimes prevail.

This soil consists of slightly weathered sandy alluvium which has been so recently deposited by the streams that sufficient time has not elapsed for the accumulation of much organic matter. The surface soil consists mainly of sand, but in most places it contains enough organic material to produce a grayish-brown or dark grayish-brown color and loamy texture. It is very loose and incoherent and in few places exceeds 6 inches in thickness. It is darkest in the depressed situations and is very light colored on the low knobs and ridges where the wind has nearly or entirely prevented the accumulation of organic matter.

Beneath the surface soil is incoherent almost pure gray sand that continues downward for several feet with little change except the presence of rust-brown mottlings, below a depth of 2 feet, and for thin layers in which the sand becomes coarser or finer in texture. Considerable gravel occurs below a depth of 2 feet in a few places.

Associated with this soil are several tracts in which the surface soil has accumulated a little more organic matter than usual and is almost dark enough for the surface layer of Cass soil. The Cass and Sarpy soils differ only in thickness and color of the surface soil, the Cass having much thicker and darker surface layers than the Sarpy. In this county none of the associated tracts has sufficiently dark or thick surface soils to be fully normal for the Cass soil, and all are included with Sarpy loamy fine sand on the accompanying map.

Owing to its low organic-matter content and sandy unstable nature, practically all of Sarpy loamy fine sand is used for grazing land, hay land, or woodland. A fairly dense growth of tall nutritious pasture grasses occurs wherever trees do not shade the ground completely. The forest growth consists mainly of cottonwood and willow trees, although elm and ash are numerous. The trees are of value mainly for fence posts and fuel.

Riverwash.—Riverwash consists of sand or clay bars, islands, and flats, adjacent to or within the channels of the Platte and Missouri Rivers. Only the larger areas are shown on the soil map. This material differs from Sarpy loamy fine sand chiefly in its less stable character. It lies from a few inches to about 2 feet above the normal level of the streams, and its boundaries are subject to change with each slight rise of the water. Even during normal flow, small areas are shifted about, added to, or removed by the varying current. The material represents the first stages of formation of alluvial soil. On becoming stabilized, much of it will develop into Sarpy soil. Most of the areas support a dense growth of small cottonwood and willow trees, although many of the smaller bodies are as yet entirely devoid of vegetation.

Riverwash is included mainly in pastures or is regarded as waste land. In some places, the trees on this land are large enough to be cut for fence posts and fuel; in others, riverwash is composed of clean sand which is used for building purposes and for surfacing roads. In the extreme southwestern part of the county, the sand has been removed from an area of about 64 acres. This area is indicated on the soil map by an appropriate symbol.
PRODUCTIVITY RATINGS

The soils of Sarpy County are classified in table 5 according to their ability to produce the more important crops of the general region. This classification compares the inherent productivity of each soil for each of the leading crops in the county to a standard, namely 100, which is the rating given a soil that is inherently the most productive in the United States for the crop under consideration and that occupies sufficient acreage to warrant classing it as the standard soil for that crop. The rating (100) is called the base index and is the standard with which the productivity of all other soils for any particular crop is compared. Thus a soil estimated to be one-half as productive of a given crop as the one having the base-index rating, receives an index of 50.
### Table 5.—Classification of soil types in Sarpy County, Nebr., according to productivity

<table>
<thead>
<tr>
<th>Soil types 1</th>
<th>Crop productivity index 2 for—</th>
<th>Principal crops or type of farming</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Corn</td>
<td>Oats</td>
</tr>
<tr>
<td>Waukessa silt loam</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>Wabash silt loam (well drained)</td>
<td>85</td>
<td>60</td>
</tr>
<tr>
<td>Wabash silty clay loam (well drained)</td>
<td>80</td>
<td>60</td>
</tr>
<tr>
<td>Lamoure silty clay loam (well drained)</td>
<td>80</td>
<td>60</td>
</tr>
<tr>
<td>Judson-Wabash silt loam</td>
<td>85</td>
<td>70</td>
</tr>
<tr>
<td>Cass silt loam (well drained)</td>
<td>80</td>
<td>60</td>
</tr>
<tr>
<td>Cass silt loam (well drained)</td>
<td>80</td>
<td>60</td>
</tr>
<tr>
<td>Wabash fine sandy loam (well drained)</td>
<td>80</td>
<td>50</td>
</tr>
<tr>
<td>Cass fine sandy loam (well drained)</td>
<td>75</td>
<td>45</td>
</tr>
<tr>
<td>Marshall silty clay loam, smooth phase</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>Marshall silty clay loam</td>
<td>65</td>
<td>60</td>
</tr>
<tr>
<td>Marshall silty clay loam, slope phase</td>
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<td>45</td>
</tr>
<tr>
<td>Carrington silty clay loam</td>
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<tr>
<td>Wabash silt loam (poorly drained)</td>
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<td>120</td>
</tr>
<tr>
<td>Wabash silty clay loam (poorly drained)</td>
<td>85</td>
<td>120</td>
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<tr>
<td>Lamoure silty clay loam (poorly drained)</td>
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<tr>
<td>Cass silt loam (poorly drained)</td>
<td>85</td>
<td>115</td>
</tr>
<tr>
<td>Cass silty clay loam (poorly drained)</td>
<td>85</td>
<td>120</td>
</tr>
<tr>
<td>Cass fine sandy loam (poorly drained)</td>
<td>75</td>
<td>105</td>
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<tr>
<td>Lancaster sandy loam</td>
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</tr>
<tr>
<td>Sarpy loamy fine sand (well drained)</td>
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<td>35</td>
</tr>
<tr>
<td>Sarpy loamy sand (poorly drained)</td>
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<td>35</td>
</tr>
<tr>
<td>Sego silty loam</td>
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<td>35</td>
</tr>
<tr>
<td>Riverwash</td>
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<td>35</td>
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</tbody>
</table>

1 This table has been prepared jointly by officials of the following organizations: Soil Survey Division, Bureau of Chemistry and Soils, and Division of Land Economics, Bureau of Agricultural Economics, U. S. Department of Agriculture; and the Conservation and Survey Division and Agricultural College, University of Nebraska.

2 Soil types inherently most productive for the specified crop in the United States are given the index 100. Only those inherently most productive soil types, of significant acreage in the more widely known crop regions, are given the standard of 100. The indexes in this table give the approximate production in percentage of the standard.

3 This column shows the approximate number of days that 1 acre will support 1 cow during the grazing season without injury to the range. The grazing season in Sarpy County is 6 months.

4 The soil is unsuited for general cultivation or farm purposes and the soil is waste land.

5 Note.—No ratings on grain and tame-hay crops are given to soils that are generally unsuited to cultivation or are farmed only in small patches.
The inherent productivity indexes are based on the ability of the soil to produce under a management that is capable of maintaining the inherent or natural level of productivity but which does not involve irrigation, terracing, drainage, or the use of fertilizers other than those produced from crops grown on the soil.

The soils are listed in the order of their general productivity which is determined chiefly by their ability to produce the more important staple crops. No attempt is made to group the soils best suited for specified crops or to account for differences in the quality of the crops.

As the soils in this county do not receive significant quantities of amendments, such as lime, phosphate fertilizer, and complete fertilizer, no rating is given to indicate their response to fertilization. The use of manure produced on the land is not considered an amendment.

The factors influencing productivity of land are mainly climate, soil, and relief, or lay of the land. As long-time crop yields furnish the best available summation of the factors contributing to soil productivity, these were among the data used in determining the inherent productivity indexes given in this table.

The rather low indexes given to some of the soils do not necessarily indicate that these soils are poorly suited for the crops grown on them. Many of the soils are among the strongest and most productive in this section. None gives as high yields of a particular crop as are obtained on what is regarded as the standard soil for that crop, but this, in the majority of instances, is due mainly to less favorable moisture conditions, surface features, or both, than occur in the section occupied by the standard soil. Most of the soils in this county contain enough plant nutrients to insure higher yields were moisture more abundant.

For the soils on the bottom lands or flood plains, two index ratings are given, one applying to the better drained areas and the other to poorly drained areas. The map, however, does not distinguish between these areas, except in localities where drainage is so poor that a marshy condition prevails the greater part of each year, and the conventional marsh symbol is used. Elsewhere on the bottom lands the poorly drained tracts, although numerous, occupy such small patches and narrow strips that they could not be legibly indicated on the published map.

Streams occasionally overflow small local tracts on the flood plains, but no productivity ratings were given to these tracts because overflow is of little importance in the agriculture of the county.

Table 5 is not based on enough of the factors which influence land use to warrant interpreting the ratings directly into specific land values. It is based on essentially permanent factors relating to the inherent productivity of the soils, and no consideration has been given transitory economic factors. In some instances the information on which the ratings are based is not so complete as desired, and further study may suggest changes.

* Data on long-time yields for specific soils were collected by the field personnel during and subsequent to the survey. Also, free use was made of unpublished estimates on average annual crop yields for the period, 1923 to 1932, inclusive, supplied by the Bureau of Agricultural Economics, U. S. Department of Agriculture, cooperating with the Nebraska Department of Agriculture.
The following tabulation gives the more important crops of the county and the acre yield that has been set up as a standard of 100 for each crop. These yields represent long-time production averages of the inherently most productive soils of significant acreage in the United States for products of satisfactory quality and are obtained without the use of soil amendments other than those produced directly or indirectly by the soil.

Crop:
Corn (grain)-------------------------------bushels--- 50
Oats-------------------------------------do--- 50
Wheat (all kinds)------------------------do--- 25
Rye-------------------------------------do--- 25
Barley-----------------------------------do--- 40
Alfalfa-----------------------------------pounds  8,000
Sweetclover--------------------------------do--- 4,000
Wild hay-----------------------------------do--- 2,000
Pasture-----------------------------------cow-acre-days per year--- 100

1 "Cow-acre-days" is a term used to express the carrying capacity of pasture land. As used here, it is the product of the number of animal units carried per acre multiplied by the number of days the animals can be grazed without injury to the pasture. For example, a soil type able to support 1 animal unit per acre for 360 days of the year rates 360, whereas another type able to support 1 animal unit per 2 acres for 180 days of the year rates 90. Again, if 4 acres of pasture support 1 animal unit for 100 days the rating is 25.

MORPHOLOGY AND GENESIS OF SOILS

Sarpy County is in the Prairie soil region of the United States. The soils have developed under midcontinental climatic conditions characterized by high summer and moderate to low winter temperatures. The mean annual precipitation as recorded at Ashland, just outside the southwestern corner of the county, is 27.09 inches. Most of it falls during the spring and summer. The relative humidity is fairly regular, the average for the year being about 70 percent. Such a climate has favored the growth of the true prairie-grass association, in which the dominant grasses on the well-drained uplands and terraces include prairie beardgrass (Andropogon scoparius), locally called little bluestem; bluejoint turkeyfoot (A. furcatus), locally called big bluestem; Kentucky bluegrass (Poa pratensis); porcupine grass (Stipa spartea), locally called needlegrass; prairie dropseed (Sporobolus heterolepis); and side-oats grama (Bouteloua curtipendula), named in the approximate order of their dominance. The same species grow more luxuriantly and in a somewhat different order of dominance on the bottom lands and other moist situations.

Forest occurs in narrow strips on many of the stream bottoms and valley sides, but the tree cover is not sufficiently dense to have prevented the growth of grass or to have notably influenced the character of the soils. Organic matter, derived principally from decayed grass roots, has given all the soils, except those developing on the most recently exposed or deposited geologic materials, dark surface layers.

The rainfall has been sufficient, except in areas where run-off is rapid, to remove the readily soluble salts from the entire solum and, in most places, from the upper part of the underlying formations; but nowhere has acidity developed so that it inhibits the growth of any farm crop common to the section. Throughout most of the county the surface soils are neutral in reaction, and the rest of the solum is slightly alkaline in reaction. In steeply sloping and severely
eroded situations where the parent materials are kept at or near the surface of the ground, some of the soils are moderately limy.

In addition to the prevailing dark color in the upper part of their profiles, all the older and more nearly mature soils have markedly granular surface and upper subsoil layers. Some of the immature soils developing from clay and silty clay sediments on the bottom lands are rather heavy, but none of them shows a tendency toward the development of a claypan.

Surface and internal drainage are good on all the soils except some of those on the flood plains. In most places throughout the uplands the slope is considerable in one direction or another, and on many of the valley sides run-off is rapid and erosion is severe. The steepest slopes are in a bluff-land strip along the Missouri and Platte Rivers around the eastern, southern, and western sides of the county, where most of the soils are immature, thin, and light-colored.

The more extensive soils have developed from a light grayish-yellow silty and floury wind-laid silt, known as Peorian loess. This material caps all the uplands and higher terraces, except in small areas where it has been removed by erosion. Formerly it presumably was limy throughout, but in this locality downward percolating waters have rather thoroughly leached the carbonates from its upper layers in all areas where the terrain is sufficiently smooth to prevent excessive loss of moisture through run-off. The loess still contains some lime in areas where it has been kept at or near the surface of the ground by erosion and in those areas in which it thinly caps less pervious beds.

The more extensive soils have developed from a light grayish-county are the Marshall soils which have developed from Peorian loess on the smoother parts of the uplands. In cultivated fields these soils are somewhat eroded, but in most of the pastures they still retain practically all of the products of soil development. They are regarded as normal soils for the Prairie soil region.

Following is a description of a profile of Marshall silty clay loam observed in a gently sloping virgin area on a high divide near Gretta in the west-central part of the county:

1. 0 to 3 inches, almost black mellow finely granular silt loam. The granules are small, soft, and poorly developed. They are mixed with considerable single-grain material.

2. 3 to 18 inches, almost black granular friable silt loam or silty clay loam. The granules are well formed, rather angular, moderately firm, and few of them exceed one-eighth inch in diameter. When the material is crushed, the color does not change noticeably.

3. 13 to 18 inches, dark grayish-brown granular heavy but friable silt loam or silty clay loam. The granules are slightly larger than in the layer above, and when crushed the material assumes a somewhat brown color.

4. 18 to 30 inches, brown coarsely granular to fine-cloppy friable silty clay loam. This is the heaviest layer of the profile, but its increased heaviness can be determined only through careful comparison with the other layers. The crushed material is light brown.

5. 30 to 55 inches, light-brown single-grain to cloppy friable silt or silt loam containing scattered rust-brown spots and splatches. The material from this layer becomes little if any lighter in color when crushed.

6. 55 to 120 inches, light grayish-brown or grayish-yellow floury and massive silt. This is the unaltered or only slightly altered loess from which the soil developed, and it continues downward for many feet with little change.
No part of the soil material is limy to the depth observed. All transitions in color, texture, and consistence between the different layers are very gradual. Organic matter is abundant and is thoroughly mixed with the mineral constituents in the upper two layers, but in the third layer it occurs chiefly as a film or coating on the surfaces of the granules, becomes thinner downward, and practically disappears at a depth of about 30 inches. Insect casts are numerous in the second and third layers, and the fourth layer contains many crooked rodlike soil forms about one-fourth inch in diameter and of various lengths, which are slightly lighter or darker than the surrounding matrix. They represent soil fillings in old root, worm, and insect holes. A very few krotovinas 10 are in nearly all areas of the soil, but none was observed in this particular exposure.

The profile described is similar in major features to that of all the nearly mature soils in this county. It is almost identical with the profile of Waukesha silt loam. The Waukesha soil, however, occupies terraces or benches, whereas the Marshall soil is on the uplands.

Although lime has been removed from the solum of most Marshall soils, some areas include a few scattered patches in which geologic lime still remains in the lower part of the soil profile. Few of the patches exceed an acre in size, and they occur chiefly in narrow strips on a few of the valley slopes, mostly near the base of the Peorian loess, where it overlies relatively impervious beds.

Areas in which the Peorian loess has been subjected to such severe erosion that the soils have been unable to accumulate much organic matter, or have been nearly or entirely removed subsequent to their development, are classed as Knox soils. These soils occupy steep slopes, sharp ridge crests, and rough and broken tracts in the bluffs along the Missouri and Platte Rivers; and they occur also on many of the valley sides throughout the rest of the uplands. At most places in the bluff areas they are moderately to highly calcareous throughout because the run-off is so rapid that raw loess is kept at or near the surface and only a little of the precipitation gets into the ground to act as a leaching agent. Throughout the interior of the county, where the land is less steeply sloping, more of the precipitation is absorbed, and the Knox soils in places are rather low in lime.

Here and there, erosion has removed the light-colored Peorian loess, also an underlying red loess on which no soils occur in this county. Here glacial drift, Dakota sandstone, or Pennsylvanian limestone, named from top to bottom in the order of their occurrence, have been exposed to weathering and soil development. In areas where these formations occur, the land is very steeply sloping or rough and broken at most places, and the soils, as a whole, are shallow and immature. Those developing on glacial drift are correlated as Carriagton silt loam, although none of this soil in Sarpy County has a profile which may be regarded as typical. The soil developing on Dakota sandstone is classed as Lancaster sandy loam and that on the Pennsylvanian beds as Sogn silt loam. In both the Lancaster and Sogn soils, bedrock outcrops in numerous places.

None of the soils on the bottom lands is old enough to have made much progress in soil development. The moist conditions have

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10 Krotovinas are irregular tubular streaks within one horizon of material but transported from another horizon.
especially favored the growth and decay of vegetation, and all the soils, except those on the most recent alluvial deposits, have dark-colored surface layers. The parent sediments, however, are so recently deposited that none of them has developed into soils having zones or layers of true soil character. Oxidation and aeration, in most places, have been retarded by excessive moisture, and the surface soils rest on the unaltered or only slightly altered alluvial sediments.

The more sandy soils of the bottom lands are classed with the Cass and Sarpy series and the more silty soils with the Wabash and Lamoure series. All except the Sarpy soils, which are light colored throughout, have almost black surface layers. None of these soils except the Lamoure contains much lime.

**SUMMARY**

Sarpy County is in east-central Nebraska, adjoining the Missouri River. It has a total area of 240 square miles. The area included is part of a former rolling to hilly drift plain which was later capped by loess and subsequently eroded by the Missouri, Platte, and Elkhorn Rivers and their local tributaries.

About 77 percent of the county is uplands, and the rest is occupied by stream terraces and flood plains. Throughout the uplands the surface ranges from undulating to extremely rough and broken. The roughest areas are in a bluff-land strip, ranging from ¼ to 2 miles in width, along the rivers around the eastern, southern, and western sides of the county. In this strip the thick loess mantle has been removed in a few places, exposing the drift deposits and the underlying sandstone and limestone bedrocks.

The terraces and flood plains occur chiefly along the Missouri and Platte Rivers, and along Papillion Creek which flows southeastward across the northern part of the county. They are for the most part nearly level, though some of the older and higher terraces are gently rolling.

Drainage is effected eastward and southward to the Missouri River. The only poorly drained land occupies a few small patches on the flood plains. Throughout much of the uplands run-off is rapid, and gullies have become a serious problem in many of the cultivated fields.

The county is in the Prairie soil region of the United States, and before settlers arrived nearly all of the uplands supported a luxuriant growth of prairie grass. Most of the sod has been broken for cultivated crops. Forest trees grow in narrow strips along many of the streams and occupy much of the rough land bordering the river valleys, but few of the trees are of merchantable size.

Well water of good but medium-hard quality is readily obtained over most of the county at depths ranging from 60 to 100 feet on the uplands and from 20 to 60 feet on the bottom lands and terraces. Some of the wells are poorly located with respect to feed yards and other possible sources of contamination.

The first permanent settlement in the area now included in Sarpy County was made in 1810, and the county was established in 1857. The early settlers were mostly of American or German birth from
Iowa and States to the east. According to the Federal census, the population in 1930 was 10,402, all classed as rural.

Transportation facilities are good. Railroads and paved, graveled, or rock-surfaced highways cross the county in several directions, connecting all towns with Omaha, the main market for surplus grain and livestock.

Rural mail delivery routes reach all sections. Telephones are on most farms, and the public-school system is highly developed.

The climate is continental and temperate, characterized by rather high summer and moderate to low winter temperatures. The mean annual precipitation is 27.00 inches and the mean annual temperature is 51.3° F. The relative humidity is consistently about 70 percent. The precipitation is deficient at times, but nearly all of the soils have high moisture-holding capacities, and crops are seldom seriously injured by drought.

The agriculture has been diversified since farming began. In 1929 the value of all crops was $2,399,148, and that of all livestock products was $735,648. Corn, the chief crop, occupies about one-third of the total land area and is followed by oats, wheat, alfalfa, barley, and rye, ranking in acreage in the order named, during most years. About 17½ percent of the county remains in native pasture or woodland, most of which is used for the grazing of cattle and the production of wild hay. Most of the crops grown are fed to cattle and hogs, which are the chief sources of revenue.

The 1935 Federal census reports the average size of the farms as 124 acres, and that owners occupied 41.5 percent, part owners 14.5 percent, tenants 43.3 percent, and managers 0.7 percent of the farms in 1935. About 41 percent of the rented farm acreage is rented for cash and the remainder for a share of the crops.

Practically no commercial fertilizer is used, but most of the available barnyard manure is applied to the land.

Most of the soils throughout the uplands and on the terraces have developed from loess, a light-gray floury silt which was deposited by the wind. A few have developed on underlying formations including glacial drift, Dakota sandstone, and Pennsylvanian limestone, but these soils occupy small areas and are of little agricultural importance.

The soils of the bottom lands are developed on a variety of stream sediments which came mainly from sections outside the county but partly from the local uplands.

Nearly all of the soils, except in severely eroded localities and on the most recently deposited stream sediments, have accumulated an abundance of organic matter, derived through the decay of prairie-grass roots, and they have very dark, in places almost black, surface layers. Most of them are highly granular, especially in the upper part, are friable throughout, and are easily penetrated by air, moisture, and crop roots. Only a few contain noticeable quantities of lime, but none seems to be deficient in lime, so far as crops are concerned.

On the basis of their drainage, depth of development, and color of surface soil, as influenced by humus content, the various soils of the county are grouped as follows: (1) well-drained dark and deep soils of the uplands and terraces; (2) well-drained moderately dark and deep soils of the uplands; (3) excessively drained light-colored and shallow soils of the uplands; and (4) variably drained soils of the
bottom lands. Although these groups are based mainly on soil features, both external and internal, each of them includes soils which have approximately similar producing powers, use capabilities, and agricultural values.

The group comprising the well-drained dark and deep soils of the uplands and terraces includes the smoother lying areas of Marshall soils, which occur on the uplands, and the Waukesha soils of the stream benches. These soils occupy 39.4 percent of the land in the county, and practically all of them are under cultivation. Corn, small grains, and alfalfa are grown chiefly. The soils are adequately drained, have deep and dark surface layers well supplied with organic matter, and are friable throughout. They are the best soils in Nebraska for general farming. None of them is as productive of corn and alfalfa as are some of the soils on the bottom lands, but all are adapted to a wider variety of crops.

Differences in crop yields on the soils of this group are owing more to differences in the relief, or lay of the land, and in its position with respect to higher and lower levels than to differences in the soils themselves. The Waukesha soil is a little more productive than the Marshall soils because it occupies lower positions and receives more moisture through run-off from higher lying areas.

The well-drained moderately dark and deep soils of the uplands consist mainly of a slope phase of Marshall silty clay loam, in addition to Carrington silty clay loam. The Marshall soil does not differ greatly in its use capabilities from the soils of the previous group, but it occupies more steeply sloping land, is more difficult to handle, and is more subject to erosion than any soil in that group. Consequently, it is a little less productive than those soils, but nearly all of it is well suited for general farming if measures are taken to retard erosion and to conserve the moisture supply. Corn, small grains, and alfalfa are the chief crops. The soils of this group occupy 13.3 percent of the area of the county.

The group which includes the excessively drained light-colored and shallow soils of the uplands comprises the Knox, Lancaster, and Sogn soils, all which are severely eroded in most places. They occupy 16.4 percent of the total area of the county.

The Knox soils rest on loess but, as a rule, occupy slopes exceeding 15 percent. Rapid surface run-off either has prevented the formation of much surface soil or has removed the surface soil subsequent to its development. In many places, the unaltered or only slightly altered loess is exposed. This material is highly productive in itself, provided care is taken to maintain an adequate supply of nitrogen, either through applications of barnyard manure or the frequent growing of leguminous crops. Practically all of the Knox soils that are not too steeply sloping for cultivation are farmed, and the rougher areas remain in pasture and woodland. Corn, alfalfa, and clover are the chief cultivated crops. Corn yields average lower than on the darker soils of the uplands, but alfalfa and clover produce about as high as on any upland soil in the county.

The Lancaster and Sogn soils are developing on Dakota sandstone and Pennsylvanian limestone, respectively. They occur on steep severely eroded valley sides and are very shallow in most places. These soils are used principally for pasture and woodland. They occupy only small patches in this county.
The group including the variably drained soils of the bottom lands comprises the Wabash, Lamoure, Cass, and Sarpy soils, and riverwash, which occupy the remaining 30.9 percent of the area of the county. Of these, the first three named have accumulated an abundance of organic matter, have very dark surface layers, and, except locally where drainage is poor, are the strongest soils of the section for the growing of corn and alfalfa. The Wabash and Lamoure soils are fine textured throughout, whereas the Cass soils are sandy, especially in their subsoils. All the soils in this group receive considerable moisture through run-off from higher land and are a little too moist for the highest yields of small grains. The Sarpy soils and riverwash are light colored and sandy from the surface downward. They are used chiefly for pasture land.
This soil survey is a contribution from

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