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Soil Survey

Lancaster County Nebraska

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UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Plant Industry, Soils, and Agricultural Engineering
In cooperation with the
UNIVERSITY OF NEBRASKA
State Soil Survey Department of the
Conservation and Survey Division

HOW TO USE THE SOIL SURVEY REPORT

SOIL SURVEYS provide a foundation for all land use programs. This report and the accompanying map present information both general and specific about the soils, the crops, and the agriculture of the area surveyed. The individual reader may be interested in the whole report or only in some particular part. Ordinarily he will be able to obtain the information he needs without reading the whole. Prepared for both general and detailed use, the report is designed to meet the needs of a wide variety of readers of three general groups: (1) Those interested in the area as a whole; (2) those interested in specific parts of it; and (3) students and teachers of soil science and related agricultural subjects. Attempt has been made to meet the needs of all three groups by making the report comprehensive for purposes of reference.

Readers interested in the area as a whole include those concerned with general land use planning—the placement and development of highways, power lines, urban sites, industries, community cooperatives, resettlement projects, and areas for forest and wildlife management and for recreation. The following sections are intended for such users: (1) General Nature of the County, in which physiography, relief, drainage, climate, water supply, vegetation, organization, population, industries, transportation, markets, and cultural development and improvement are discussed; (2) Agriculture, in which a brief history and a description of the present status of the agriculture are given; (3) Productivity Ratings and Land Classification, in which are presented the productivity of the soils, which are grouped according to their relative physical suitability for agricultural use; and (4) Land Use and Management, in which the present use of the soils is described, their management requirements are discussed, and suggestions made for improvement in management.

Readers interested chiefly in specific areas—as some particular locality, farm, or field—include farmers, agricultural technicians interested in planning operations in communities or on individual farms, and real estate agents, land appraisers, prospective purchasers and tenants, and farm loan agencies. These readers should (1) locate on the map the tract with which concerned; (2) identify the soils on the tract by locating in the legend on the margin of the map the symbols and colors that represent them; and (3) locate in the table of contents in the section on Soils the page where each type is described in detail and information given as to its suitability for use and its relations to crops and agriculture. They will also find useful information in the sections on Productivity Ratings and Land Classification and on Land Use and Management.

Students and teachers of soil science and allied subjects—including crop production, forestry, animal husbandry, economics, rural sociology, geography, and geology—will find their special interest in the section on Morphology and Genesis of Soils. They will also find useful information in the section on Soils, in which are presented the general scheme of classification of the soils of the area and a detailed discussion of each type. For those not already familiar with the classification and mapping of soils, these subjects are discussed under Soil Survey Methods and Definitions. Teachers of other subjects will find the sections on General Nature of the County, Agriculture, Productivity Ratings and Land Classification, and the first part of the section on Soils of particular value in determining the relations between their special subjects and the soils of the area.

This publication on the soil survey of Lancaster County, Nebr., is a cooperative contribution from the—

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UNIVERSITY OF NEBRASKA
State Soil Survey Department of the Conservation and Survey Division
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Series 1938, No. 15 Issued May 1948

SOIL SURVEY OF LANCASTER 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

CONTENTS

SETTLEMENT in Lancaster County was begun in 1856 by white men attracted to the area by saline deposits along Salt Creek. The first crops grown were corn, potatoes, garden vegetables, and flax, which produced well on new land. Present agriculture consists of diversified farming—grain, hay, and livestock. Wheat is the main cash crop, with corn, oats, alfalfa, clover, timothy, and potatoes as other principal crops. Minor feed crops include barley, rye, spelt,

[1] The field work for this survey was done while the Division was a part of the Bureau of Chemistry and Soils.

kafir, grain sorgums, millet, and Sudan grass. The county ranks second in the State as an industrial center, producing farm machinery, harness, tools, beverage, tobacco and candy products, clothing, furniture, and home furnishings in addition to agricultural products. Limestone and sandstone quarries furnish material for constructing roads and buildings. To provide a basis for the best uses of the land a cooperative soil survey was begun in 1938 by the United States Department of Agriculture and the University of Nebraska, State Soil Survey Department of the Conservation and Survey Division. The report here presented may be briefly summarized as follows:

SUMMARY

Lancaster County, in the southeastern part of Nebraska, is part of a dissected glacial-drift plain that was covered to various depths by two silty wind-laid loess formations. In many places dissection has removed both of these known deposits, exposing the glacial drift and locally the bedrock formations known as Dakota sandstone and Permian limestone and shale.

In its general physiographic aspect the county is a broad elongated basin, its axis followed throughout by Salt Creek, tributaries of which have produced minor irregularities in the outline of the basin. The uplands are moderately to strongly rolling. The greatest relief is in West Oak, Little Salt, Elk, and Denton Precincts, whereas the smoothest uplands are on a high northeast-southwest divide across the southern tier of precincts. The nearly level or gently undulating alluvial lands, principally along Salt Creek and its larger tributaries, occupy a relatively small part of the county.

Drainage is chiefly northward and eastward to the Platte River through Salt Creek and its tributaries. The extreme southern and southeastern parts are drained by tributaries of the Big Blue and Nemaha Rivers. As a whole the county is well drained.

The county is in the Prairie soil region of the United States, and before settlers arrived nearly all the uplands supported a luxuriant growth of prairie grasses. Over most of the arable land the sod has been broken for cultivated crops. Forest trees grow in narrow discontinuous strips along the larger streams.

All the soils have developed under the influence of a vegetation of tall grass except those occupying part of the bottom lands and part of the most steeply sloping areas. Most of them are very dark and highly granular in the surface layers, friable throughout, and easily penetrated by air, roots, and water. Only a few contain significant quantities of lime, but so far as crops are concerned none seems to be deficient in calcium.

On the basis of use capability and productivity, as influenced chiefly by depth and friability of soil material and character of parent material, the soils are grouped as follows: (1) Deep and medium-deep friable soils of the loessal uplands; (2) deep heavy soils of the loessal uplands; (3) deep and medium-deep friable soils of the glacial uplands; (4) deep heavy soils of the glacial uplands; (5) shallow friable soils of the glacial and bedrock uplands; (6) deep friable soils of the terraces; (7) deep heavy soils of the terraces; and (8) alluvial and colluvial soils.

The first group includes the Sharpsburg soils. These soils, occupying the undulating to gently rolling loess-mantled uplands, are the most extensive in the county. They have a dark surface soil, clayey but fairly friable subsoil, and ample fertility, and are among the most productive in this general region. Most of these soils are cultivated and are used for all the crops common to the Corn Belt.

The deep heavy soils of the loessal uplands include the Butler and Crete series. These differ from those of the Sharpsburg chiefly in having a dense claypan layer in the upper part of the subsoil and a horizon of lime enrichment in the lower part. They are used for growing all the crops common to this region but are better suited to small grains than to corn.

The deep and medium-deep friable soils of the glacial uplands include the Carrington and Burchard series. The Carrington soils are much like the Sharpsburg, although the former have developed from glacial drift instead of loess, have a more clayey and consequently a little heavier subsoil, and contain more sand and gravel. The Carrington soils are used for growing all crops common to the region. They are a little less productive than the Sharpsburg. Associated with the Carrington are some areas of the Burchard, in which the drift-derived soils, although otherwise similar to those of the Carrington, have an abundance of lime in the lower part of the subsoil, commonly at a depth of about 30 inches. The soils are not extensive enough to be of much importance in the agriculture of the county.

The deep heavy soils of the glacial uplands comprise a single type of the Pawnee series. This differs from Butler and Crete soils mainly in having a little sand and some gravel in the profile and in having a substratum of drift instead of loess. The upper part of the subsoil is claypanlike and the lower part has a horizon of lime enrichment. Like Butler and Crete, the soil is used principally for corn but is better suited to small grains, mainly wheat, which can usually mature before the moisture stored near the surface during spring and winter is exhausted. Corn, which requires moisture for longer periods, frequently suffers from drought, owing to the character of the subsoil.

The shallow friable soils of the glacial and bedrock uplands are of the Steinauer, Sogn, Lancaster, and Dickinson series. The Steinauer soils are developed on glacial drift consisting of silt, clay, sand, and gravel; the Sogn on limestone; the Lancaster on sandstone; and the Dickinson on loose sandy deposits in the drift. All these soils are unimportant in extent, and most of them are either too steeply sloping, too stony, or too severely eroded to be of value for cultivation and are used as pasture.

The deep friable soils of the terraces are included in the Waukesha series. These soils have developed from silts and are essentially like those of the Sharpsburg in profile features but are on terraces instead of uplands. Nearly all are under cultivation, are highly productive, and are admirably suited to all crops common to the area.

The deep heavy soils of the terraces are in one type of the Rokeby series. This soil has developed from silt, has a claypan and a horizon of lime enrichment, and is distinguished from the Butler type, which is on the uplands, by its lower physiographic position. It is used for growing all the common crops of the area but is best suited to small grains.

The alluvial and colluvial soils comprise the Wabash, Lamoure, Bremer, and Judson series, all of which occupy the lower parts of stream valleys. These soils are highly productive and are mostly under cultivation. Corn and alfalfa are the principal crops on the bottom lands, which receive considerable runoff from higher land and are a little too wet for the highest yields of small grains.

Except in small steeply sloping or severely eroded areas, practically all the soils of the county are well suited to cultivation. Even the severely eroded areas are highly productive where the moisture is conserved and an adequate nitrogen supply is maintained by the frequent use of legumes in crop rotations. Under the present system of farming at least 30 percent of the precipitation that falls on the arable soils runs off the land and another 30 or possibly 40 percent evaporates before it can be of significant benefit to crops. Facilities to conserve the precipitation for plant use therefore are the chief requirements for increased crop production.

GENERAL NATURE OF THE COUNTY

LOCATION AND EXTENT

Lancaster County is in the southeastern part of Nebraska (fig. 1). Lincoln, the county seat and State capital, is in the central part; Omaha, the metropolis of the State, 50 miles to the northeast. The

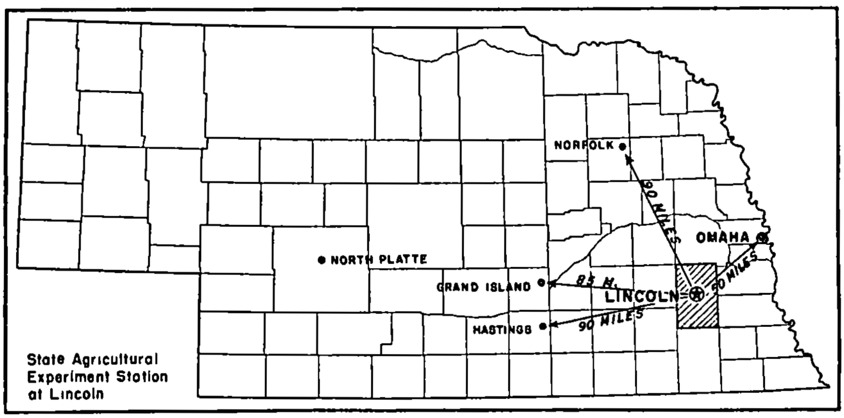

FIGURE 1.—Location of Lancaster County in Nebraska.

county is rectangular, being 36 miles long from north to south and 24 miles wide from east to west, and comprises 843 square miles, or 539,520 acres.

PHYSIOGRAPHY, RELIEF, AND DRAINAGE

The county lies in the loess-drift hills region of Nebraska,[2] a part of the Central Lowland province of the Interior Plains physiographic division. The hills and narrow upland plains of this division were formed by the dissection of a glacial drift plain that was later covered

[2] CONDRA, G. E., and REED E C. THE GEOLOGIC SECTION OF NEBRASKA Nebraska Geol. Survey, Conserv. and Survey Div., Univ of Nebr. Bul. 14, 82 pp., illus. 1943.

to various depths by two wind-laid formations known as Loveland loess (lower) and Peorian loess (upper). Most of the Loveland, a reddish-brown slightly sandy silt, was removed by erosion prior to the deposition of the Peorian and the rest was covered by the Peorian. The Loveland is exposed in many deep road cuts and gullies, but no soils of significant acreage have formed on it. The predominant soils of the uplands have developed or are developing on the Peorian loess, a light-gray floury silt. In many places, recent erosion has removed both loess deposits, exposing the underlying glacial drift upon which extensive areas of soils have developed, and locally the loess and drift are so eroded as to expose small areas of bedrock, known as Dakota sandstone and Permian limestone and shale, named from the surface downward in the order of their occurrence.

In its general physiographic aspect, the county is a broad elongated basin, shallowest in the southwestern part and gradually deepening northeastward. The axis of this basin is followed throughout by Salt Creek, the most important tributaries of which are Beal Slough, Little Salt, Rock, Oak, Middle, and Camp Creeks, and Haines Branch. These streams have produced minor irregularities in the outline of the basin.

In their detailed aspect the surface features correspond, in a general way, to those of the old Kansan drift plain. Prior to the depositions of loess this plain was subjected to dissection, which made it strongly rolling to hilly. Its irregularities were later reduced somewhat by the loess deposits but were not effaced except where least pronounced. Recent dissection has produced the present relief.

The uplands are moderately to strongly rolling. The greater part of the slopes range from 80 to 700 feet long and from 4 to 9 percent in gradient. The longer and more gradual slopes are some distance from the larger drainageways. The greatest relief is chiefly in West Oak, Little Salt, Elk, and Denton Precincts, adjacent to the large stream valleys. Here most of the hills and ridges are 40 to 60 feet high, are well-rounded on top and have sloping sides ranging from 7 to 15 percent in gradient and 80 to 350 feet in length.

The smoothest uplands are on a high northeast-southwest divide across the southern tier of precincts. On this divide the surface of the old drift plain was comparatively smooth and the loess cover effaced many of such slight irreguarities as existed, making the relief as a whole undulating to gently rolling, except for about 4 square miles in the vicinity of Princeton and over smaller tracts near Hallam, Firth, and Panama, where the surface is nearly level. Other small upland areas having little relief are on some of the narrower divides near Cheney, southeast of Berks, west of Walton, and south of Prairie Home.

Alluvial lands, including stream terraces and flood plains, are principally along Salt Creek and its larger tributaries and occupy only a small proportion of the total land area. The terraces were formed before the streams became so deeply entrenched and are now 10 to 30 feet above the present bottom lands. The larger and higher terraces are chiefly along Salt Creek in the vicinity of Lincoln and Waverly and in the northeastern part of Centerville Precinct. They were formed before the loess was deposited, were covered with the wind-laid loessal material at the same time as the uplands, and only their basal parts are water-laid. Most of them are near the level of the Todd Valley terrace, described in the Soil Survey of Saunders County, Nebraska.[3] The terraces are nearly level, except near their outer margins and adjacent to small drainageways issuing from the uplands, where narrow strips of gently to steeply sloping land occur.

The lower terraces are chiefly along Little Salt, Rock, Oak, Middle, and Camp Creeks, Beal Slough, and Haines Branch. They are smaller than the higher terraces, are strictly water-laid, are composed mainly of loessal material washed from the uplands and redeposited by water along the streams, and, except for barely perceptible sags along old overflow channels, are nearly level. Few of them are subject to inundation or abnormal erosion. The transition from the terraces to the flood plains, or first bottoms, is marked by a short steep slope in most places, whereas that from the terraces to the uplands is commonly gradual.

The first bottoms occupy broken or continuous strips bordering all the larger and many of the smaller drainageways. They are only a few feet above the streams and are subject to frequent overflow. Those along Salt Creek and its larger tributaries are more than a mile wide in several places, but elsewhere they range in width from a few rods to about half a mile. Except where modified by active or abandoned stream channels, slight elevations, and shallow depressions, the first bottoms are nearly level, with a slight slope downstream.

In general, the county is well drained, chiefly northward and eastward to the Platte River through Salt Creek and its tributaries. The extreme southern and southeastern parts are drained by tributaries of the Big Blue and Nemaha Rivers. Intermittent drainageways thoroughly ramify the uplands except in a few nearly level areas on some of the divides, where surface runoff is slow. In places where the slopes are rather steep, some of the drainageways are actively deepening and are becoming injurious gullies. The main channels of Salt, Rock, Oak, and Middle Creeks have been dredged and straightened in their lower courses. The only poorly drained areas are in local patches on the flood plains and in a few small and widely scattered depressions on the smoother parts of the uplands and terraces. Most of these areas are drained by open ditches, though a few are drained by tile.

The average elevation of the uplands is about 1,400 feet above sea level, ranging from 1,520 feet on the high divide in the southern part to 1,100 feet where Salt Creek crosses the eastern county boundary. Elevations [4] at various towns within the county are as follows: Cheney, 1,428 feet; Hallam, 1,475; Hickman, 1,241; Waverly, 1,121; Raymond, 1,215; and Malcolm, 1,280.

CLIMATE

The climate is continental and temperate. Variations in temperature and precipitation between winter and summer are rather wide, as is typical of the Corn Belt, but the climate is well suited to the

[3] MEYER, A. H., SMIES, E. H., BUSHNELL, T. M., and others. SOIL SURVEY OF SAUNDERS COUNTY, NEBRASKA. U. S. Dept. Agr., Bur. Soils Field Oper. 1913, Rpt. 15: 2001–2058, illus. 1916.

[4] GANNETT, H. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. U. S. Geol. Survey Bul. 274, ed. 4, 1072 pp. 1906.

production of grain, vegetables, hay crops, and livestock. Cool springs and considerable rainy weather favor rapid growth of winter wheat and spring-planted small grains. In the long summer the warm days and nights are especially favorable for the growth of corn. The long and pleasant fall has only occasional periods of rainy weather, giving the farmer ample time to harvest the corn crop and prepare and seed the land for winter wheat. Low winter temperatures are usually of short duration and are acompanied by snow, which protects the winter-grown crops from serious injury. Differences in relief are not sufficient to cause appreciable differences in the local climate.

The normal monthly, seasonal, and annual temperatures and precipitation, as compiled from the records of the United States Weather Bureau station at Lincoln in the central part of the county, are given in table 1.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Lincoln, Lancaster County, Nebr.*[1]

[Elevation, 1,180 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total for the driest year	Total for the wettest year	Average snowfall
	°F	°F	°F	Inches	Inches	Inches	Inches
December	27 6	72	−20	0 80	0 88	1 96	4.8
January	22 8	68	−29	.64	1 64	1 02	4.9
February	26 1	79	−26	95	.68	.14	6 4
Winter	25 5	79	−29	2 39	3.20	3 12	16.1
March	37.5	91	−11	1 27	18	.37	4.8
April	51 5	97	15	2.53	2 29	67	1.1
May	61.7	98	25	4.08	1 95	3 65	.1
Spring	50 2	98	−11	7 88	4 42	4 69	6.0
June	71 4	106	43	4.32	1 13	8.83	0
July	76 5	110	48	3 85	.08	11 35	0
August	74 4	109	42	3.57	1 63	4 35	0
Summer	74 1	110	42	11 74	2 84	24 53	0
September	66 4	106	27	2 98	3 38	4 10	0
October	54 2	92	3	1 88	.19	2 81	.5
November	39 1	80	−15	1 07	06	1 97	1 7
Fall	53 2	106	−15	5 93	3 63	8 88	2 2
Year	50.8	[2] 110	[3] −29	27 94	[4] 14 09	[5] 41.22	24.3

[1] Data from U. S Weather Bureau records.
[2] In July 1911.
[3] In January 1892.
[4] In 1936.
[5] In 1902.

The average date of the last killing frost is April 18, and that of the first is October 15, which indicates an average frost-free season of 180 days, ample for maturing and harvesting all the crops commonly grown. Killing frosts have occurred as early as September 12 and as late as May 10.

About 83 percent of the mean annual precipitation falls from April to October, the 7 months comprising the growing season. In summer the rainfall usually occurs as heavy thundershowers, but torrential rains are rare. Droughts are almost unknown in May and June, but dry periods sometimes occur in the latter part of July and during

August. Crops seldom suffer from lack of moisture when properly tended, as nearly all the soils are able to supply sufficient moisture through periods of dry weather. Hail may damage crops over small areas in some years, but the injury is local and does not reduce the aggregate yield to a great extent.

From about February 1 to May 1 the prevailing wind is from the north, and during the rest of the year from the south. Strong winds are common, but tornadoes are rare. The average annual wind velocity is 10.5 miles an hour. The relative humidity is fairly regular, the average for the year being about 64 percent. Over a period of 26 years, the average hours of sunshine annually was 2,819.

WATER SUPPLY

Good but medium-hard well water in sufficient quantity for family and livestock needs is readily obtained over most of the county. Throughout most of the uplands it comes mainly from lenses and buried channels of sand and gravel in the glacial-drift deposits and from sandstone bedrock at depths of 40 to 100 feet. Locally, as in the vicinity of Roca and near Bennet, potable water is obtained from limestone and sandy shale formations, but this supply is limited and rather uncertain. The depth to water in any locality on the uplands depends partly on the character of the relief and the thickness of the loessal cap, but chiefly on the thickness and textural composition of the drift deposits and on the depth to suitable aquifers in the bedrock. Water occurring at depths of more than 250 feet below the level of the uplands usually is too salty to drink.

Throughout most of the alluvial lands an abundance of good water commonly is obtained from sandy stream-laid sediments at depths of 20 to 30 feet. Much of the water from wells in the bottom lands along Salt Creek and the lower courses of its larger tributaries is salty, but most of that from wells in the bottoms along the other streams is very good. A limited supply of drinking water is obtained from springs at or near the contact of the drift and bedrock formations, but only a few farmers along the sides of the larger valleys, where wells are rather uncertain, depend on this source. Several of the springs issuing from the base of slopes along lower Salt Creek are slightly saline. Streams provide a limited supply of water for livestock needs only. Most of them are intermittent, many are dry most of the year, and much of the water from the remaining ones is not potable. Natural freshwater lakes do not exist. A few small artificial lakes or ponds scattered over the county furnish some water for livestock and local recreation. Salt Lake is suitable for limited recreational purposes only.

More thought should be given to the location and care of wells. Water moving over and through polluted ground may affect the quality of the well water. It is not uncommon to see shallow, poorly cased open wells immediately below feed yards and other sources of contamination, where they receive sediment and surface debris from surrounding land. Most schoolyards and many of the better managed farms have drilled wells.

VEGETATION

This county is in the Prairie soil region of the United States, and before white men arrived all the uplands supported a luxuriant growth of prairie grasses. Trees were on the bottom lands along most of the larger and many of the smaller streams and on numerous valley slopes, but even in these situations grasses were commonly dominant. Except on some of the steeper or more stony areas and in many of the narrower and less accessible bottom-land strips, practically all the virgin soil has been broken for cultivated crops or orchards. The grasses in scattered virgin areas on the uplands consist mainly of little bluestem, needlegrass, side-oats grama, junegrass, and prairie dropseed. On the better drained uncultivated areas of the bottom lands big bluestem, Indian grass, and wild-rye are abundant, whereas, sloughgrass, sedges, and cattails are most common in the poorly drained areas. Saltgrass and wheatgrass grow on the more saline parts of the bottom lands. The present forests are confined chiefly to steeply sloping areas and to numerous narrow flood plains along meandering streams. They consist largely of elm, ash, cottonwood, and boxelder trees in the lower places and of bur oak on the steeper slopes. Most trees are not of merchantable size but are of value for posts, fuel, and shade for livestock. Small groves of elm, ash, maple, walnut, hackberry, pine, and cedar trees have been planted near the building site on many farms, chiefly for shelter purposes.

ORGANIZATION AND POPULATION

The first settlement in the county was made by John D. Prey in 1856 along Salt Creek. Another settlement called Lancaster was made by W. T. Donavan in 1857 near what is now Salt Lake. This settlement was abandoned, but its name was given to a village later established on what is now a part of the present site of Lincoln. The county was formed from unorganized territory in 1859. The Territorial legislature enlarged it to its present size in 1863 by the addition of a part of what was then Clay County to the south. The village of Lancaster was made the county seat in 1864. It was selected for the capital of Nebraska and was renamed Lincoln in 1867. The State records were transferred from Omaha to Lincoln in 1868.

The early settlers were mainly from Iowa, Illinois, Indiana, Missouri, Pennsylvania, and other States to the east. Most of them, chiefly of German, Dutch, Irish, and Swedish descent, were American-born.

According to the 1940 census the population of the county was 100,585, 81.5 percent of which was classed as urban and the rest rural. The rural population averaged 22 persons a square mile. Except near Lincoln and in the immediate vicinity of the towns and villages, the rural population was rather evenly distributed and has increased steadily since early settlement began.

Lincoln, the only city, had a population of 81,984 in 1940. This city is an important wholesale and retail center for manufactured goods and farm produce. The University of Nebraska, a United States veterans hospital, a penitentiary, a State hospital, and a reformatory are located here. The small towns of Waverly, Bennet, Firth, Hickman, Roca, Malcolm, Denton, Raymond, Davey, Hallam, and Panama having about 500 inhabitants or less and a number of smaller villages are scattered throughout. They serve as shipping points for farm implements, supplies, and produce. Most of them have grain elevators and cream stations.

INDUSTRIES

Lancaster County ranks second in the State as an industrial center. In addition to its agricultural products, it produces a wide variety of commodities, and has wholesale and retail markets. Farm machinery, harness, tools, beverages, tobacco and candy products, clothing, furniture, and home furnishings are manufactured in Lincoln, where also are numerous printing and publishing companies and important wood- and metal-working concerns. Brick and tile are made from clays of the Dakota formation that outcrops near Lincoln. Crushed stone for use in concrete structures and for surfacing roads is quarried from the sandstone and limestone bedrock formations. The largest quarries are on limestone near Roca. Most of the stone from these formations is rather soft. Small quantities of sand and gravel for local use in constructing roads and buildings are obtained at numerous places from drift deposits.

TRANSPORTATION AND MARKETS

Transportation facilities are good, and no part of the county is more than 10 miles from a shipping point. Railroads and State and Federal highways radiate from the State capital in all directions and furnish good connection with outside markets. The public-road system is well developed, and nearly all towns are on paved or gravel-surfaced roads. Many of the minor roads are of earth construction, but are well maintained and nearly all have concrete culverts or bridges. Ordinarily, the roads follow land-survey lines, except in the rougher parts, where they conform to the relief. Air transportation is facilitated by two commercial airports near Lincoln.

The county has excellent marketing facilities, and the local demand for farm produce is good. Much of the dairy and poultry output is processed in Lincoln and later shipped to outside markets. A meat-packing plant and flour, cereal, and feed mills in Lincoln process a part of the meat and grain produced in the county and adjacent areas. Omaha and South Omaha markets receive most of the farm products not consumed in the county.

CULTURAL DEVELOPMENT AND IMPROVEMENT

The public school systems are highly developed and include consolidated schools in some of the rural districts. The State University and several other educational institutions in and near Lincoln afford excellent facilities for advanced education in the arts and sciences and in commercial fields. Churches are well distributed, and rural mail routes reach all sections.

Salt Lake, near Lincoln, is an important local recreational center, but in recent years has been used less than formerly, owing to a decreased water supply. Artificial lakes, including Oak Park Lake in the northwestern part of Lincoln and other smaller lakes and ponds scattered over the county, provide local recreational facilities and some water for livestock.

In general, the farm buildings are kept in good repair. Most of the houses are 2-story wooden structures, many of them equipped with modern conveniences, as furnaces, running water, refrigeration, radios, and various electrical devices for doing housework. The 1940 census reports 1,386 farms with dwellings lighted by electricity and 1,439 with telephones.

As a rule barns and other outbuildings are large enough to house the livestock, the more expensive farm machinery, and all crops except hay, which is generally stacked in the field or near the feed yards. Most farms are enclosed with barbed wire, but many have woven-wire fencing, especially around the feed lots and pastures.

AGRICULTURE

EARLY AGRICULTURE

Lancaster County is essentially agricultural. Prior to the entry of the white man the land supported dense stands of tall sod-forming grasses, together with a growth of trees along many of the streams. The Indians who lived here subsisted largely on wild game, fish, and native fruits. A few, however, grew small quantities of corn and vegetables to supplement their meat diet.

The first white men were attracted to the area by the saline deposits along Salt Creek. Owing to inadequate transportation facilities it was difficult for the pioneers to obtain salt, consequently the early squatters located along Salt Creek and evaporated salt from the saline waters. The salt was sold to the Indians, hunters, trappers, and settlers. Many of the early farmers would exchange a wagonload of flour for one of salt—pound for pound. The salt, however, was found to be less abundant and more difficult to purify than was expected and its production for sale ceased after railroad connections were established.

Early settlement was slow until 1859, when the overland trail to the West was changed to a more direct route through this territory. Some trouble was experienced with the Indians until 1864, when the United States Government placed them on definite reservations.

The pioneers homesteaded along the bottom lands where fuel and water were most plentiful. Settlement of the uplands was comparatively rapid after the more desirable valley land had been taken.

The first crops consisted largely of corn, potatoes, and garden vegetables, grown mainly for home consumption; and flax, which produced well on new land and was the chief cash crop.

Earlier farmers did not think that spring wheat would be profitable or that winter wheat could survive in this latitude, consequently they grew corn and flax most extensively. After about 1870 they began to test the possibilities of wheat production and "tea" wheat was grown for several years as a spring wheat. This was superseded by "grass" wheat, which also was grown as a spring wheat until about 1888, when the farmers accidentally discovered that it could be grown as winter wheat. This caused a considerable increase in wheat acreage, but corn remained the leading crop. At first the number of livestock was small and the animals required little feed aside from that supplied by prairie grasses on the open range.

As settlement intensified and transportation facilities and other cultural development gradually expanded, agriculture became more diversified. The present agriculture includes growing grain, hay, and forage crops, raising and fattening livestock, chiefly cattle and hogs, and the production of livestock products.

CROPS

The principal crops are corn, wheat, oats, alfalfa, clover, timothy, and potatoes, ranking in acreage during most years in the order named. The total acreage of these crops and of a few of the minor crops, including fruits and vegetables, is given in table 2.

TABLE 2.—*Acreage of the principal crops and the number of bearing apple and peach trees and grapevines in Lancaster County, Nebr., in stated years*

Crop	1879	1889	1899	1909	1919	1929	1939
Corn:	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Harvested for grain	92,550	171,073	236,310	165,592	147,736	167,455	113,455
Cut for silage	-	-	-	-	-	2,589	8,308
Hogged or grazed, or cut for fodder	-	-	-	-	3,749	7,709	5,145
Oats:							
Threshed	12,482	44,624	55,731	52,209	42,980	42,873	27,079
Cut and fed unthreshed	-	-	-	-	-	499	823
Wheat	55,191	2,907	8,619	67,469	104,901	82,548	110,002
Barley	2,886	282	597	82	1,428	1,031	13,519
Rye	921	683	1,019	42	675	200	1,942
Sorghums:							
Harvested for grain	-	-	-	-	-	19	6,209
Cut for silage	-	-	-	-	-	-	6,678
Cut for hay or fodder	-	-	-	-	[1] 2,221	[2] 1,221	15,773
Hay, total	36,264	88,492	47,885	59,472	56,708	49,285	25,942
Alfalfa	-	-	1,361	9,963	23,256	25,984	11,856
Timothy or clover, alone or mixed	-	-	2,089	15,512	4,557	2,405	[3] 425
Other tame hay	-	-	7,206	1,858	1,690	1,310	1,392
Wild hay	-	-	37,229	32,139	27,205	19,586	12,269
Potatoes	135,348	4,347	3,033	2,267	1,802	1,602	715
Market vegetables	-	-	-	-	92	557	330
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Apples .... trees	-	75,961	170,500	127,859	24,409	11,546	985
Peaches .... do	-	1,211	32,535	52,191	1,406	4,968	757
Grapevines	-	-	35,189	47,200	21,202	24,873	814

[1] Includes kafir.
[2] Includes sorghums for silage.
[3] Sweetclover
[4] In bushels, acreage not reported.

The value of crops and livestock products by classes for certain years, as compiled from the Federal census, is shown in table 3.

TABLE 3.—*Value of crops and livestock products by classes in Lancaster County, Nebr., in certain years*

Product	1909	1919	1929	1939
Cereals	$3,520,554	$11,009,034	$5,656,981	$2,018,157
Corn harvested for grain	(1)	(1)	3,378,502	774,364
Wheat threshed	(1)	(1)	1,774,646	993,888
Other cereals	(1)	(1)	503,833	249,905
Other grains and seeds	17,105	11,067	12,432	4,644
Hay and forage	748,675	1,689,450	938,421	475,744
All vegetables	172,181	344,330	290,155	68,812
For sale [2]	(1)	(1)	56,237	19,766
For farm household use [2]	(1)	(1)	81,673	20,736
Potatoes and sweetpotatoes	(1)	(1)	152,245	28,310
Fruits and nuts	102,438	97,950	61,533	1,174
Horticultural specialties sold	(1)	(1)	249,198	106,989
All other crops	145,971	3,270	686	426
Forest products sold	(1)	(1)	9,835	1,477
Livestock sold and slaughtered	1,661,702	(1)	(1)	994,010
Cattle and calves	(1)	(1)	(1)	524,779
Hogs and pigs	(1)	(1)	(1)	452,949
Sheep and lambs	(1)	(1)	(1)	16,282
Dairy products sold	388,402	752,948	1,206,552	851,762
Whole milk	(1)	(1)	803,891	727,320
Cream [3]	(1)	(1)	389,424	121,915
Butter	(1)	(1)	13,237	2,527
Poultry and eggs produced	405,730	743,328	1,155,798	572,891
Wool shorn	29,925	13,115	7,788	4,770
Honey produced	[4] 1,006	[4] 1,860	3,718	413

[1] Not available.
[2] Excluding values of potatoes and sweetpotatoes.
[3] Includes values of both sweet cream and sour cream (butterfat)
[4] Includes value of wax.

As the number of livestock increased and the acreage used for grazing was reduced, more feed crops were required. Farmers soon realized that the soils and the climate were well suited to growing oats, which provided excellent feed for livestock. Prior to 1880 the acreage in oats increased greatly at the expense of other small grains, until between 1889 and 1899 it exceeded that of wheat. During most of the years since farming began, however, wheat has ranked second in acreage and oats third. In recent years the areas used for some of the soil-depleting crops, such as corn and wheat, have been restricted and soil-improvement crops, including clover and alfalfa, have been grown more extensively, but corn, wheat, and oats still occupy the greater part of the arable land. The combined area used for wheat and oats is about two-thirds of that used for corn.

The minor feed crops include barley, rye, spelt, kafir, grain sorghums, timothy, clover, millet, and Sudan grass. During most years, the acreage used for forage and tame hay fluctuates in accordance with the number of livestock. In some years the acreage in sorghum is increased considerably because of a shortage of other feed crops. The sorghums are more drought resistant than many of the tame hay and forage crops commonly grown during years of normal precipitation, develop quickly, and usually can be grown late in summer after crops planted earlier have failed.

Crop yields vary widely from year to year and from place to place, partly in accordance with differences in the soils and character of the relief but mainly with differences in the quantity and distribution of the precipitation and the length of the growing season. For the county as a whole, however, the average yield per acre of most crops is fairly uniform from year to year.

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 grown more or less on all of the cultivable land. Ordinarily, the largest proportional acreage is on the well-drained bottom lands rather than on the uplands because the corn plant adapts itself better to bottom-land conditions than do small-grain crops. Likewise, corn occupies a larger part of the more steeply sloping arable uplands, where small grains do well but are harvested with considerable difficulty. Small grains are grown mainly on the smoother parts of the uplands and on the terraces, where few of the slopes exceed 7 percent and where large machinery, such as binders and combines, is used easily. Alfalfa is grown most extensively on the terraces and flood plains, where moisture is most abundant. Much of the sweetclover is grown in rotation with grain crops on rolling or steeply sloping lands, where it aids in retarding runoff and erosion and in restoring nitrogen, which is exhausted rapidly on sloping areas under continued grain cropping. Most of the more nearly level lying soils are used more or less continuously for grain production. Some of the lighter colored, silty, and more friable soils of sloping areas are used for orcharding, especially on northward-facing slopes not too steep for cultivation. A part of the dark well-drained sandy soils of the bottom lands is used for growing truck crops.

Practically all crops except wheat are consumed on the farm where produced or within the immediate vicinity. Ordinarily, the wheat and some of the corn are grown to sell for cash but since early days wheat has remained the principal cash crop and most of the corn, oats, alfalfa, and wild hay have been used locally for feed. All crops not needed for home consumption are disposed of readily in Lincoln or Omaha.

Most farmers grow fruits and vegetables for home consumption and a few grow truck crops to sell in the city markets. On many tenant farms the supply of fruit is not sufficient to meet the family needs. Several commercial nurseries and greenhouses are located in or near Lincoln.

Most of the uncultivated land, except that used for wild hay, is included in pastures occupied mainly by areas that are either too excessively or too poorly drained for cultivation or are difficult to farm because of stream dissection, small size, or unfavorable location. These areas provide considerable grass and some timber. On most of them the native bluestem, formerly predominant, has been replaced by bluegrass, which became established on most of the uncultivated land since the county was settled and which now is the leading pasture grass. The better pastures include considerable white clover and some bluestem and dropseed grasses. Some of the native grasses on the poorly drained saline bottoms are of inferior quality, but they constitute only a small part of the total pasture. A few of the more progressive farmers grow tame grasses and legumes to supplement their native pasture.

AGRICULTURAL PRACTICES

Cropping practices are similar to those in other counties of southeastern Nebraska. Corn, the principal crop, is planted in May either in checkrows with a planter or in furrows with a lister. Ordinarily the land is plowed and a seedbed is prepared before planting. The crop is cultivated at intervals of 2 or 3 weeks until early in July, after which it receives little attention until harvest. It matures in September or by the middle of October. Most of the grain is husked from the standing stalks by hand, after which livestock are pastured in the fields during the winter. Many farmers cut a part of the corn for fodder or silage and a few enclose small acreages of unhusked corn for fattening cattle and hogs, thereby reducing the cost of harvesting.

All the corn grown is of the white and yellow dent varieties. Reid Yellow Dent, Iowa Silvermine, and hybrids of these are common. Locally grown seed is used mostly because it is better adapted to the soil and climatic conditions and usually yields better than those imported. The tendency is to select the smoother and heavier dimple-dented ears for seed. Tests have shown that this seed produces less leafy and somewhat earlier maturing plants, which require less moisture for development and yield higher than plants from seed of the rougher deep-kerneled ears.

During recent years hybrid corn has been grown on a rapidly increasing acreage. The hybrid seed is rather expensive but the yields obtained are 10 to 20 percent higher than from ordinary seed. Most of it is produced locally or under climatic and soil conditions similar to those prevailing in the county.

Treatment of seed corn to prevent diseases is not generally practiced. Smut and root rot are the chief diseases of the corn crop. Smut is carried over from year to year in the fields and thus the treatment of seed is rather ineffective, especially when corn is grown during consecutive years on the same ground. Root rot is best controlled by careful hand selection and testing the seed ears.

Practically all the wheat is of the winter varieties, chiefly Cheyenne and Turkey Red. Ordinarily this crop follows oats in rotation, but occasionally it is seeded between the rows of standing corn or on land from which the corn has been removed for fodder or silage. The seed is planted with a press drill in September. Generally the crop makes good growth before killing frosts occur and remains practically dormant during winter; it resumes growth in spring and usually matures early in July. It is cut either with a binder or a combine. When cut with a binder it is shocked or stacked for threshing. A combine cuts and threshes the crop in one operation. Most of the grain is hauled to market directly from the threshing machine.

Wheat yields may be reduced by bunt, or stinking smut, which distorts the kernels, stunts their normal growth, and gives the grain an offensive odor. This form of smut can be controlled by treating the seed with copper carbonate powder before planting, at the rate of 2 ounces of powder to 1 bushel of grain.[5]

Ordinarily the hessian fly is not a serious pest, but it may cause some damage to very early seeded fields of wheat. Such injury may best be avoided by delaying the sowing of the seed wheat until the fly-free date is announced by the State entomologist. Early preparation of the seedbed is of prime importance. Experiments show that the yield of winter wheat on early-prepared land is about double that produced on fields plowed late. Small-grain stubble land plowed or listed in July and kept free from weeds until seeding time has produced 29 bushels of wheat an acre on Carrington clay loam at the Nebraska Agricultural Experiment Station. Apparently the increased yield on land prepared early is due to the accumulation of soil moisture and nitrates through the maintenance of favorable tilth and the prevention of weed growth prior to planting time.

Oats are not very profitable but are grown extensively because they are needed to feed work animals and young livestock and because they provide a good nurse crop for legumes and tame grasses. They yield best on the nearly level uplands and terraces. Ordinarily they follow corn in the rotation but are grown on all the arable soils whenever needed as a nurse crop. Early-maturing oats are grown, chiefly Kherson or strains of this variety and some Burt. Part of the land to be used for oats is plowed before planting time, but usually the land is disked thoroughly and the seed is broadcast or drilled late in March or early in April. The crop matures during the latter part of June or in July and is harvested in much the same manner as wheat. Most of it is consumed on the farms where produced. The yield of oats may be reduced by smut, especially during prolonged periods of damp weather. Smut injury can be controlled by treating the seed, after it has been fanned or cleaned, with a solution containing 1 pint of commercial formaldehyde to 35 gallons of water.

Barley is grown, harvested, and used in much the same manner as oats. It fits into most rotations equally well and is as good a nurse crop for legumes and grasses. It ranks next to corn in terms of feed produced an acre and yields about one-third more feed than oats.

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[5] Nebraska University Agricultural College Extension Service, Departments of Agronomy and Plant Pathology. CEREAL SMUTS AND THEIR CONTROL. Nebr. Agr. Col. Ext. Cir. 126, 8 pp., illus. 1925.

Many farmers are profitably reducing their acreage in oats in favor of barley. A moderate acreage in barley will insure some feed for livestock when drought and other unfavorable weather conditions reduce the corn crop. The chief barley varieties grown are Spartan and Oderbrucker.

Rye is not an important crop. It is grown to some extent for grain but mostly for temporary spring and fall pasture for brood sows and small pigs. When grown for grain, it is planted and harvested the same as wheat. Rosen is the chief variety.

Alfalfa, the leading hay crop, is planted with a press drill, not deeper than 1 inch, in a thoroughly prepared seedbed during April or early May or during August or early September and commonly with a small-grain nurse crop. If seeded in fall, it should be sown as soon after a heavy rain as possible. Seed sown in spring usually produces a better stand, owing to the higher moisture content of the soil. The standard seeding rate is 15 pounds an acre. Only pure certified seed from the most hardy varieties obtainable is used, as Grimm, Common, and Cossack, which are resistant to drought and winterkilling.

The alfalfa plant is a perennial and grows either from seed or the old root stalk. It is best adapted to fine-textured moist soils and does well on nearly all the soils of the county. Ordinarily, a stand of alfalfa is allowed to remain on the land as long as it yields satisfactorily, generally 4 or 5 years on the uplands and 5 or 6 years on the bottom lands. The crop is rarely frozen out. It is usually cut three times during the summer and occasionally four times.

In most years the alfalfa plant is not able to make optimum growth on the seasonal precipitation alone. It is therefore not considered good practice to grow alfalfa on the uplands too many years in succession, as the subsoil moisture is likely to be exhausted after four or five seasons, resulting in reduced yields of hay. Likewise, difficulty may be experienced in obtaining satisfactory yields of other crops when seeded on upland fields that have been in alfalfa for several years. According to investigations at the Nebraska Agricultural Experiment Station,[6] this is because of the exhaustion of the subsoil moisture, the supply of which is restored very slowly after the alfalfa sod is broken, because most of the annual rainfall is used by the new crop grown on the land. Similarly, yields from a second planting of alfalfa are likely to be lower than those obtained from the first, even though several years may have elapsed between the plantings. Such results do not take place on the soils of the bottom lands, where the alfalfa roots are able to obtain sufficient moisture directly from the water table.

Clovers and timothy are commonly sown with oats or barley in spring in much the same manner as alfalfa, are pastured lightly in fall after the small-grain crop has been harvested, and are used chiefly for pasture and to some extent for hay or seed the following years. They are sometimes sown on wheatland late in winter or early in spring and the seed harrowed or rolled in, but winter wheat is not a good nurse crop, and a poor clover or timothy stand is obtained more

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[6] KIESSELBACH, T. A., RUSSELL, J. C., and ANDERSON, A. THE SIGNIFICANCE OF SUBSOIL MOISTURE IN ALFALFA PRODUCTION. Amer. Soc Agron. Jour. 21: 241–268, illus. 1929.

often than when the seed is sown with a small-grain crop planted in spring.

The sweetclover plant is a biennial and grows only from seed. It thrives either on fine- or coarse-textured soils and on wet or dry ones. If enough of the plants are allowed to reseed the second year and each successive fall thereafter, a good stand of sweetclover can be maintained on almost any field indefinitely. When grown for hay, the crop is cut before the vegetative growth becomes coarse and woody, or fibrous, and usually during the first year only. Beginning with the second year, it must be allowed to reseed itself if a consecutive crop is desired. When grown for seed, the crop is harvested with a binder or a combine in much the same manner as small grain after the seed has matured.

The timothy plant is a perennial and grows either from seed or from an old rootstalk. It does not thrive on dry sandy soils but is well adapted to silty or fine-textured moist soils and grows well on most soils in the county. The crop may be pastured or cut for hay or seed each consecutive year indefinitely as long as the stand remains intact.

Clover, timothy, and alfalfa aid in regulating runoff and in controlling erosion and are important in maintaining soil fertility. In common with other legumes, clover and alfalfa also have the power of fixing atmospheric nitrogen in the soil through the action of nodules on their roots, thereby making this essential plant nutrient available to those successive crop plants requiring it. The use of sweetclover as a green-manure crop and soil builder is increasing annually, especially on steeply sloping eroded uplands. Many farmers prefer sweetclover to alfalfa for soil improvement because it is adapted to a wider range in soil and moisture conditions and to much shorter crop rotations. Sweetclover roots also grow large and vigorous and decay rapidly after the second year's growth. Tests fail to show the need or any beneficial effects of liming or innoculation for the successful production of either sweetclover or alfalfa on most soils in the county.

Definite systems of crop rotation are not followed generally, although the more progressive farmers use rather definite systems, subject to numerous substitutions. On most farms the crops grown from year to year are determined more by current demand and price than by the requirements of the soil. A rotation that seems to have merit and is used successfully by some farmers on the more nearly level lying areas of the Sharpsburg and Carrington soils is corn 2 years, oats 1 year, wheat, rye, or barley 1 or 2 years, and sweetclover or red clover 2 years. Occasionally alfalfa is substituted for the clover but as it does not lend itself well to short rotations, it is seldom grown unless it can be left on the ground at least 4 years.

On the more rolling areas of Sharpsburg, Carrington, and other arable soils, corn and small-grain acreages should be reduced in favor of legume acreages in order to maintain an adequate nitrogen supply and to curtail erosion. On steep slopes, where farming is difficult and where grain yields are low because of excessive loss of moisture through runoff, the land can be planted to clover and grasses and used advantageously as permanent pasture land.

Although alfalfa and the clovers do best on Bremer and the better drained Wabash and Lamoure soils of the bottom lands, they are not

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needed in rotations here as frequently as on the uplands. On most of the alluvial soils corn can be grown 3 or 4 years in succession without a serious decrease in yield. The land can then be used 1 or 2 years for small grains and 3 years or more for alfalfa before it is used again for corn.

Practically no commercial fertilizer is used except on some of the truck gardens, where the quantity and the composition vary greatly. According to the Federal census, only 5 farms used commercial fertilizer in 1939, at a cost averaging $52.20 each. A large quantity of barnyard manure is produced but much of it is wasted. On many farms it is piled outdoors, where most of its value is lost through leaching. The best results are obtained by farmers who apply manure in fall or spring to the sandy soils of the bottom lands and to the light-colored and eroded soils of the uplands. On tenant farms little care is taken to put the manure where it is most needed and the greater part is spread at random and when most convenient on the fields nearest the feed yards.

Little attention is given to the management of pastures, which on most farms are small and are used only to provide grazing for the milk cows and work animals. Many of the pastures have been greatly harmed by overgrazing and drought and now are occupied chiefly by weeds, shrubs, and annual grasses of low feed value.

LIVESTOCK AND LIVESTOCK PRODUCTS

The returns derived from livestock and livestock products are the main sources of revenue on most farms, and the number of livestock maintained on any given farm is determined largely by the quantity of feed produced. The number of domestic animals, poultry, and bees on farms in certain years, as compiled from the Federal census, is shown in table 4.

TABLE 4.—*Number of livestock*[1] *on farms in Lancaster County, Nebr., in stated years*

Livestock	1900	1910	1920	1930	1940
	Number	*Number*	*Number*	*Number*	*Number*
Horses	17,513	19,454	17,564	13,517	[2] 3,224
Mules	1,553	2,157	2,771	2,707	[2] 1,371
Cattle	52,905	46,164	44,274	47,888	[2] 33,060
Swine	83,376	60,583	54,500	64,473	[3] 10,349
Sheep	2,373	10,957	4,837	7,736	[4] 3,379
Goats	27	48	16	139	[3] 109
All poultry	[2] 237,325	[2] 246,772	301,486	([5])	[3] 262,185
Chickens	[2] 227,467	([5])	296,944	[2] 333,003	[3] 258,141
Bees ...hives	2,883	1,309	669	1,124	173

[1] Animals of all ages as of census dates, except 1940.
[2] Over 3 months old
[3] Over 4 months old.
[4] Over 6 months old
[5] Not available.

Most of the beef cattle are produced locally from small herds of grade Hereford and Shorthorn, but a few are shipped in for fattening. These cattle are fed corn and alfalfa for a period of 60 to 90 days and then are shipped to the Omaha or Lincoln markets. Many farmers fatten one to five carloads each year. A few calves are fattened for shipment as baby beef. When first weaned, the calves are fed oats, but later the ration is changed to corn and alfalfa. They are shipped when 14 to 18 months old.

Purebred dairy cattle, chiefly Holstein-Friesian, Guernsey, and Jersey, are kept on a few dairy farms near Lincoln but the greater part of the dairy products is obtained from small herds scattered throughout the county. Many of the smaller herds are of mixed beef and dairy breeding. Most farmers milk 5 to 10 cows throughout the year. Milk routes are established in all parts and most of the milk is collected at the farm by the purchaser. A cream station is maintained in nearly every town and several large creameries are in Lincoln. The greater part of the milk and cream produced within the county and considerable quantities from outside sources are processed and consumed at Lincoln.

Most farmers raise 20 to 60 hogs annually and some have 100 or more, chiefly Duroc-Jersey, Poland China, and Hampshire. Most of the hogs are of good breeding and many are purebred. They are usually fattened on corn and alfalfa meal, but ground barley and rye may be added to the ration, and young pigs generally receive some oats. Practically all the hogs are fattened on the farms where raised and sold in the Lincoln or Omaha markets. Many are fed in connection with the feeding of beef cattle. Hog cholera and necro-bacillosis have disastrously affected hog raising in the past, but these diseases have been largely eliminated through vaccination and increased sanitation.

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

The raising of horses and mules has been of minor importance during recent years and is confined mainly to breeding enough work mares to meet a limited demand for local farm power. Most farmers raise a colt or two each year. Nearly all the work animals are of heavy draft or general-purpose types and are well suited to farm work. An average of 8 head of work animals, including colts, are kept on each 160 acres where other power, such as tractors, is not used. Farmers having tractors for the heavier work usually keep only about 4 head. Sleeping sickness and extremely high summer temperatures have reduced the number of work animals considerably during recent years, but a sufficient number remain to meet most farm requirements.

Chickens, chiefly purebred Plymouth Rock, White Leghorn, and Rhode Island Red, are raised on nearly every farm to supply home needs. Many flocks number several hundred. Some are maintained through the purchase of certified baby chickens from hatcheries in Omaha and Lincoln. A few farmers raise and fatten large numbers of turkeys for sale. Nearly all of the surplus poultry and eggs are sold or exchanged for farm supplies in the local towns.

Except for wheat and part of the truck and vegetables grown for cash sale, most crops are used on the farm where produced or within the county, chiefly for raising and fattening cattle and hogs and for feeding work animals and breeding stock. On most farms, enough feed is produced to meet the needs of the livestock raised on the land. Farmers who raise and fatten large numbers of cattle and hogs purchase considerable corn and oats annually, either locally or through markets from outside sources. In 1939, 1,898 farmers, or 65.1 percent of those in the county, each spent an average of $251.67 for feed.

TYPES OF FARMS

With few exceptions the type of farming that prevails on any given farm has not changed significantly for a considerable period. It varies rather widely, however, on many of the farms in accordance with differences in relief and drainage, character of soil, size of farm, location with respect to towns, and the financial status of the farm operator. Other factors, as suitability of the land for institutional use, for a country estate, for recreational purposes, or for tourist lodging, have also caused wide differences in the type of farming, especially in the vicinity of Lincoln.

The cash-grain type of farming is practiced on the largest number of farms and on the largest total acreage and is most common on the Sharpsburg and Carrington soils of the uplands. This type requires a minimum acreage in legumes and is practiced more by tenant than by owner operators. General farming is common on all of the well-drained and more nearly level lying parts and is practiced extensively on the Waukesha, Bremer, and Judson soils. It usually includes the growing of legumes, the raising of livestock, and the maintenance of a satisfactory system of crop rotation. Farms used mainly for dairying, fruit growing, or poultry raising are usually rather small. Most of them are on Waukesha and Wabash soils of the stream valleys near Lincoln.

The classification of farms by major source of income in 1939 is as follows:

	Number of farms		*Number of farms*
Livestock	386	Vegetables	12
Dairy products	375	Horticultural specialties	13
Poultry and poultry products	157	Farm products used by farm households	377
Field crops	1,551		

LAND USE

In 1939, 91.9 percent of the land in the county, or 496,957 acres, was occupied by 2,915 farms; and 85.8 percent of the farm acreage, or 426,181 acres, was classed as improved land. Most of the farms range in size between 70 and 380 acres. Many of those in the immediate vicinity of Lincoln and some of the other towns are small and only a few include more than 500 acres. The average size, 170.5 acres, is slightly larger than when the county was settled. Many of the smaller farms have been acquired by loan companies who combined them into larger units. Some of the more prosperous farmers have increased their holding through purchase.

Although the crop acreage varies considerably from year to year with fluctuations in prices and the demand for farm products, the relative acreages of the different crops remain fairly constant over long periods. Uncultivated areas support grass and in some places considerable timber and are used mainly for pasture land. Only a few wild-hay meadows remain and these are confined to poorly drained tracts on the bottom lands and to the smoother parts of the more steeply sloping uplands. None of the land is used exclusively for forestry. Most of the timbered areas are pastured.

FARM TENURE

In 1940 owners operated 46.8 percent of the farms, tenants 52.3 percent, and managers 0.9 percent. The proportion of tenant farms has increased steadily from 29.2 percent in 1880. Both cash and share rental systems or a combination of the two are followed. In 1940, 84.8 percent of the tenant farmers rented for a share of the crops. Under this system the owner usually receives two-fifths of the grain delivered to the crib or granary, half the alfalfa hay stacked in the field, and $1.00 to $2.50 an acre for the pasture land and building site. On some farms the owner receives half the corn crop. All seed, labor, machinery, and power are furnished by the tenant. Under the cash rental system the tenant commonly pays $3 to $5 an acre for the use of all the land, including hay and pasture areas and building sites. On some farms the tenant pays $6 to $8 an acre for use of the better grade farm land. Only a small part of the land used for growing grain crops rents for cash. Most of the areas suited only for pasture land rent for a lump sum, the price per acre depending mainly upon the type of soil, the quality of the grass, and the accessibility of the pasture. The well-drained bottom-land pastures have the highest rental value. On farms having small and rather poor pastures the tenant commonly is allowed the use of the grazing land without charge.

In general, up to 1940, farm laborers were plentiful and wages low because of the economic depression. In that year the wages in summer were $20 to $30 a month and in winter about $14 a month, with board and lodging furnished by the employer. Labor was usually plentiful at $1 to $2 a day, although as high as $3 was paid during the small-grain harvest season. Corn huskers usually received 3 to 4½ cents a bushel. Many farmers hire help to harvest their crops but only a few use hired labor throughout the year. In 1939, 795 farms (27.3 percent) reported an expenditure of $175,902 for wages, or an average of $221.26.

FARM INVESTMENTS

The selling price of individual farms varies considerably, depending chiefly on general economic conditions, character of soil, drainage, surface features, cultural developments, and location with respect to markets. Soil and drainage conditions being comparable, the farms having the best improvements and those located most advantageously to markets and other cultural developments are valued more highly than remotely situated farms that have few or no improvements. Other things being equal, the most valuable farms usually consist chiefly of the Waukesha, Bremer, and Wabash soils of the well-drained stream terraces and flood plains, and the Judson soils on the colluvial slopes. The Sharpsburg and Carrington soils occurring on the nearly level, undulating, and very gently sloping well-drained uplands also are valued very highly for most general farming purposes. The moderately sloping areas of these soils, which have not been damaged appreciably by erosion, and most of the Butler, Crete, and Rokeby soils are less valuable than some but are considered average. The cheapest land includes the saline phases of the Wabash and Lamoure soils, most other poorly drained areas, and all shallow soils on the steeply sloping, excessively drained, or severely eroded parts of the county.

Data on the number of farms in the county are given in table 5. These include the average size, the average per-acre value of the land, the total invested value of all farm property per farm, and the percentage of the total value invested in land, buildings, machinery, and livestock, as compiled from the Federal census for certain years.

TABLE 5.—*Number of farms; average size and value per acre; total value per farm of all property; and percentages of total value in land, buildings, machinery, and livestock for stated years*

Year	Farms			Total value, all property	Invested value of farm property per farm in—			
	Total	Average size	Average value per acre		Land	Buildings	Implements and machinery	Livestock
	Number	*Acres*	*Dollars*	*Dollars*	*Percent*	*Percent*	*Percent*	*Percent*
1900	3,585	143 5	33 91	6,577	74 0	11 8	2.6	11 6
1910	3,410	149 5	82 50	15,693	78 6	11.4	2.0	8 0
1920	3,259	155 8	159 75	30,737	81 0	9 7	3 6	5 7
1930	3,170	158 3	[1] 125 50	22,435	71 6	17 0	4 3	7.1
1940	2,915	170 5	[1] 55 73	11,078	63 8	22 0	6 5	7 7

[1] Includes buildings

The average value per acre of most farms in the county is slightly higher than that of most farms occurring on comparable land in adjacent counties. This results from more adequate market and transportation facilities and more advanced cultural development.

Farm machinery is of the most modern and labor-saving types. In 1940, 1,516 tractors were reported on 1,426 farms, 499 motortrucks on 454 farms, and 3,048 automobiles were on 2,651 farms. Many farms are equipped with grain threshers, combines, corn binders, corn huskers, hay bailers, silage cutters, silos, incubators, and cream separators.

SOIL SURVEY METHODS AND DEFINITIONS

Soil surveying consists of examining, classifying, and mapping soils in the field and recording their characteristics, particularly in regard to the growth of various tilled crops, grasses, and trees.

The soils and the underlying formations are examined systematically in many locations. Test pits are dug, borings are made, and road or railroad cuts and other exposures are studied. Each excavation exposes a series of distinct soil layers, or horizons, termed collectively the soil profile. Each horizon, as well as the underlying parent material, is studied in detail, and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The chemical reaction of the soil and its content of lime and salts are determined by simple tests.[7] The drainage, both internal and external, and other external features, including relief, or lay of the land, are taken into consideration, and the interrelation of the soil and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, with special emphasis upon the features that influence the adaptation of the land for the production of crop plants,

[7] The reaction of the soil is its degree of acidity or alkalinity, expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality; higher values, alkalinity; and lower values, acidity. Indicator solutions are used to determine the chemical reaction. The presence of lime is detected by the use of a dilute solution of hydrochloric acid.

grasses, and trees. On the basis of these characteristics the soils are grouped into classification units, the principal three of which are (1) series, (2) type, and (3) phase; some areas may be of such intimate or mixed pattern that they cannot be clearly shown separately on a small-scale map but must be mapped as (4) a complex.

The series is a group of soils having the same genetic horizons, similar in their important characteristics and arrangement in the profile and having similar parent material. Thus, the series comprises soils having essentially the same color, structure, natural drainage, and other important internal characteristics and the same range in relief. The texture of 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. Sharpsburg, Butler, Carrington, Judson, and Wabash are names of important soil series in Lancaster County.

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

A soil phase is a variation within the type, differing from it in some minor feature, generally external, that may be of special practical significance. For example, within the normal range of relief of a soil type some areas may be adapted to the use of machinery and the growth of cultivated crops and others may not. Differences in relief, stoniness, and degree of accelerated erosion may be shown as phases. Even though no important differences may be apparent in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated crops. In such instance the more sloping parts of the soil type may be segregated on the map as a sloping or hilly phase. Similarly, some 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, and complexes, in relation to roads, houses, streams, lakes, section and township lines, and other cultural and natural features of the landscape.

SOIL SERIES AND THEIR RELATIONS

All the soils in Lancaster County have developed under the influence of a luxuriant vegetation of tall grass, except part of those on the bottom lands and part of those on the most steeply sloping uplands. Trees are common on many of the bottom lands and on the steepest upland slopes but are too widely spaced to have prevented the growth of grasses or to have appreciably influenced soil character. The annual decay of grass roots has produced an abundance of black well-decomposed organic matter, and nearly all the soils have accumulated enough organic remains to make their surface soils dark, regardless of the color of the underlying parent material. The intensity of the darkness and the depth to which the dark color has penetrated depend largely on relief, drainage, and the length of time the soil has lain in its present position undisturbed by abnormal erosion.

In the most nearly level parts, decomposed organic material is most abundant and has penetrated deeply into the soils, a little deeper, as a rule, in the well-drained than in those poorly drained. On the steeper slopes most of this material was removed before or shortly after it decomposed, and the soils are light colored even at the surface. Between these extremes of drainage and relief, the content and the depth of penetration of the organic matter varies mainly with the degree of slope. The areas where organic accumulations have been most restricted are along deeply entrenched drainageways, on the shoulders of hills, and on the narrow ridge tops where cultivation has promoted accelerated erosion. The total area of light-colored soils is not large.

In addition to their prevailingly dark color, most of the soils are characterized by a granular structure in their upper layers, this feature persisting to a greater or lesser extent in all except the most sandy soils. It is best developed on the soils of the well-drained uplands and terraces, where a distinct granular structure commonly extends to a depth of 24 inches or more.

A third fairly uniform characteristic of the soils is the occurrence of available calcium in sufficient quantities for most crop needs. This characteristic is less pronounced than dark color or granular structure. None of the soils has an appreciable quantity of lime (calcium carbonate) in the surface layer and few have an abundance of this material in the subsoil. Nevertheless, none of the soils shows evidence of a serious deficiency of calcium, and only in scattered fields are increased yields obtained when lime is applied. Thick limestone layers outcropping at several places will afford an ample supply of easily obtained lime for use when the soils begin to respond more favorably to its application.

With only a few exceptions, the soils are friable and easily penetrated by air, roots, and water. In the southern part of the county are large areas in which a claypan subsoil restricts downward moisture penetration, but these heavy soils lie nearly level in most places and commonly have friable thick surface layers that absorb moisture readily. Thus the injurious effects of the claypan are greatly reduced. Nearly all the soils have a high moisture-holding capacity, but few are porous enough to absorb more than a small part of the precipitation as rapidly as it falls. As a result, much of the rainfall is lost through runoff and evaporation without becoming available to plants. Over the county as a whole, the runoff alone probably removes more than 25 percent of the mean annual precipitation, and, since farming began, it has considerably thinned the surface soils in many of the cultivated fields. Almost none of the land, however, has been made useless for cultivation by improper farming practices, and on the more nearly level areas practically no damage has occurred, but in some of the fields where slopes exceed 5 percent [8] the soils have been noticeably damaged by water erosion.

Except in small scattered areas the soil material is more than 3 feet thick over the bedrock. Practically all the deep soils, except those in the bottom lands, and the greater part of the shallow soils overlie either loess or drift, which in most places contains enough of the essential plant nutrients, except nitrogen, for the satisfactory growth of all the grain and tame hay crops commonly produced. These materials, therefore, may lie near the surface without seriously injuring the productivity of the soil, provided enough nitrogen is supplied through legumes or manure and the land is not too steeply sloping for cultivation, and for the maintenance of an adequate supply of moisture. A few small areas in which either sandstone or limestone bedrock is at or near the surface are too stony for cultivation, but even these areas may be used advantageously as pasture land.

The three rather persistent characteristics—high organic-matter content of the surface soil, granular structure of this layer, and calcium in the subsoil sufficient for most crop needs—are valuable soil assets in connection with crop production. Organic matter is a strong absorbent of both heat and moisture. It increases the rate of moisture absorption and the water-holding capacity of the soil and assists in maintaining a uniform soil temperature. It also promotes favorable tilth, retards water erosion, and is the chief source of nitrogen, which is an important plant nutrient. The granular structure facilitates root penetration and the free movement of air and water, which help change the raw vegetal and mineral constituents into nutrients for growing crops.

The individual soils vary considerably in many external and internal characteristics, with corresponding variations in productivity and suitability for use. It is possible, however, to group them so that the soils of each group have a similar use suitability and productivity and are used for some particular crop or crops more extensively than soils belonging to another group. In this county eight such groups are recognized, as follows:

(1) Deep and medium-deep friable soils of the loessal uplands, (2) deep heavy soils of the loessal uplands, (3) deep and medium-deep friable soils of the glacial uplands, (4) deep heavy soils of the glacial uplands, (5) shallow friable soils of the glacial and bedrock uplands, (6) deep friable soils of the terraces, (7) deep heavy soils of the terraces, and (8) alluvial and colluvial soils. The soil series that belong to each of the groups and the outstanding features of these series are given in table 6.

[8] A slope of 5 percent is one in which the land rises or falls 5 feet vertically in a horizontal distance of 100 feet. All other slope percentages are defined similarly.

TABLE 6.—*The soil groups and characteristics of the soil series in Lancaster County, Nebr.*

Soil group	Soil series	Dominant relief	Drainage		Texture and consistence of subsoil	Lime content in subsoil	Depth of soil profile	Parent material
			External	*Internal*			*Inches*	
Deep and medium-deep friable soils of the loessal uplands	Sharpsburg	Nearly level to rolling	Medium to slow	Medium	Friable silty clay	Low	36+	Loess.
Deep heavy soils of the loessal uplands.	Butler	Nearly level to undulating	Slow to medium	Very slow	Heavy clay	Moderate	36+	Do
	Crete	Undulating to gently sloping.	Medium to rapid	Slow	Moderately heavy silty clay or clay	do	36+	Do
Deep and medium-deep friable soils of the glacial uplands	Carrington	Nearly level to rolling	do	Medium to slow	Moderately heavy silty clay or sandy clay.	Low	36+	Kansan drift
	Burchard	Undulating to hilly	Medium to very rapid.	do	do	High	24-30	Do
Deep heavy soils of the glacial uplands	Pawnee	Undulating to rolling	Medium to rapid	Very slow	Heavy clay	Moderate	36+	Do
Shallow friable soils of the glacial and bedrock uplands	Steinauer	Hilly or steeply sloping	Very rapid	Medium to slow	Moderately heavy silty clay or sandy clay	High	12−	Do
	Sogn	do	do	Medium	Stony	do	12−	Permian limestone and shale
	Lancaster	Gently to strongly sloping	Medium	Rapid	Loose and sandy	Low	24−	Cretaceous sandstone
	Dickinson	Gently rolling to steeply sloping	Very slow	do	do	do	24−	Sandy glacial outwash.
Deep friable soils of the terraces.	Waukesha	Nearly level	Medium	Medium	Friable silt	do	36+	Alluvial silt
Deep heavy soils of the terraces	Rokeby	do	Slow to medium.	Very slow	Heavy clay	Moderate	36+	Alluvial silt and clay.
Alluvial and colluvial soils.	Wabash	Nearly level bottom land	Slow	Slow	Moderately heavy silty clay or clay	Low	36+	Do
	Lamoure	do	do	do	do	High	36+	Do
	Bremer	Nearly level low terraces or high bottom.	do	do	do	Low	36+	Do
	Judson	Gentle colluvial slope	Medium	Medium	Friable silt	do	36+	Alluvial-colluvial silt

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 some variation exists in drainage conditions and in other characteristics that affect agriculture, as surface features of soils, direction of slope, moisture, lime, and organic-matter content, texture, and stoniness. In addition, the farming systems and the crops grown may differ somewhat 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 in the quantity and distribution of the local precipitation. Over long periods, however, the soils of each group give the largest returns from the crop or crops best suited to their moisture supply and to their texture, consistence, and other characteristics and are used chiefly for these crops. In establishing these eight groups, recognition is given to soil and crop adaptations and also 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 soil groups, the soil series in these groups, and the individual soils of the different series are described, and the cropping possibilities of the soils discussed; the soil map accompanying this report shows the distribution of the soils in the county; and table 7 gives their acreage and proportionate extent.

TABLE 7.—*Acreage and proportionate extent of the soils mapped in Lancaster County, Nebr.*

Soil type	Acres	Percent	Soil type	Acres	Percent
Bremer silt loam	4,928	0 9	Lancaster sandy loam	576	0 1
Burchard clay loam	13,504	2.5	Pawnee silty clay loam	45,248	8.4
Hill phase	3,392	.6	Rokeby silty clay loam	2,880	.5
Butler silty clay loam	12,416	2 3	Sharpsburg silty clay loam	90,432	16.8
Carrington loam	4,096	8	Level phase	256	(1)
Rolling phase	8,832	1 6	Rolling phase	43,200	8.0
Steep phase	11,136	2 1	Sogn silt loam	64	(1)
Carrington silty clay loam	18,240	3.4	Steinauer loam	12,992	2 4
Rolling phase	42,368	7 9	Steinauer-Burchard complex	2,048	4
Steep phase	4,288	.8	Wabash fine sandy loam	1,536	.3
Crete silty clay loam	51,712	9 6	Wabash silt loam	64,000	11.9
Crete-Sharpsburg silty clay loams	37,888	7.0	Wabash silty clay	2,304	.4
Dickinson sandy loam	640	.1	Saline phase	6,976	1 3
Judson silt loam	832	.2	Waukesha silty clay loam	17,984	3.3
Judson-Wabash fine sandy loams	1,728	3	Undulating phase	10,944	2.0
Judson-Wabash silt loams	15,168	2 8			
Lamoure silty clay	2,944	6	Total	539,520	100 0
Saline phase	3,968	.7			

[1] Less than 0.1 percent.

DEEP AND MEDIUM-DEEP FRIABLE SOILS OF THE LOESSAL UPLANDS

Deep and medium-deep friable soils of the loessal uplands occupy 24.8 percent of the area of the county. The Sharpsburg series represents this group on the loess-mantled uplands in nearly all parts.

SHARPSBURG SERIES [9]

The Sharpsburg series is composed of silty stone-free soils of excellent tilth, characterized by a dark, thick, friable surface layer with

[9] Areas of soil mapped in Lancaster County as Sharpsburg silty clay loam join areas mapped in Cass County as Marshall silty clay loam. It has been recognized for some time

an abundance of organic matter and a highly developed fine-granular structure. The surface layer is a little darker and thicker than that in most of the other soils of the uplands. The subsoil, which is thick and well oxidized, contains a little more clay than the surface soil but is fairly friable throughout. In the upper part, just below the surface soil, it is very dark brown and gradually becomes lighter colored downward. The parent Peorian loess, a light-gray floury wind-deposited silt, is more than 3 feet thick in nearly all areas, and in many it is more than 10 feet thick. Sharpsburg soils are all well supplied with plant nutrients. Neither the soils nor the underlying weathered loess contains free lime except in small and widely scattered patches usually at or near the base of slopes, but none of the soils indicates a calcium deficiency so far as crop needs are concerned.

All Sharpsburg soils are well drained, have a high water-holding capacity, and are among the most productive of the uplands in the United States for growing corn, alfalfa, and small grains. They are well suited to any crop common to the Corn Belt and are easily managed where reasonable care is taken to control erosion and conserve moisture. Under conditions of equal precipitation and similar farming practices the yields vary mainly with differences in the degree of slope, which in a large measure determines the quantity of water that is absorbed and becomes available to the crops.

DEEP HEAVY SOILS OF THE LOESSAL UPLANDS

The deep heavy soils of the loessal uplands occupy 18.9 percent of the area of the county. They include soils belonging to the Butler and Crete series, which differ from the deep friable soils of the loessal uplands chiefly in having in the upper part of the subsoil a dense claypan that absorbs water slowly, thus restricting downward moisture penetration, and in having in the lower part a horizon of lime enrichment.

BUTLER SERIES

The only Butler soil represented is a Planosol developed on Peorian loess. It is characterized by a heavy dense claypan in the upper subsoil and a horizon of lime enrichment in the lower. The surface layer is nearly black, finely granular, and friable to a depth of 14 to 16 inches. It merges abruptly with the very dark dense clay of the upper subsoil. A pronounced layer of leached gray silt ranging from a thin film to about 4 inches thick is not uncommon in the lower surface soil between the dark surface layer and the claypan, or upper subsoil. Neither the surface layer nor the upper subsoil is noticeably calcareous. The subsoil is grayish-brown or grayish-yellow, limy, and moderately compact silty clay or silty clay loam at a depth of 24 to 36 inches. Below a depth of 3 or 4 feet is floury Peorian loess similar to that beneath the Sharpsburg soils. The loess contains little or no free lime.

The Butler soil suffers little loss of moisture through runoff and has not been damaged seriously by erosion. External drainage is slow to medium and internal drainage very slow. All crops common to the area are grown easily and successfully on most areas, but yields of

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that the soils called Marshall in this vicinity of Nebraska are heavier than the more representative Marshall silt loam, particularly in the subsoil, and are probably derived from a somewhat different kind of parent material. These differences have been taken into consideration in the soil nomenclature for Lancaster County in the recognition of the newly established Sharpsburg series.

many crops are generally slightly lower than those obtained on Sharpsburg soils because of a less abundant supply of moisture during the growing season. The dense subsoil apparently does not release moisture fast enough to meet the demands of many plants during the drier months, and the surface soil is unable to store enough water to sustain them for more than short periods. Small grains, maturing early in summer on moisture stored in the surface soil, do better as a rule than corn, which requires moisture over a longer period. During seasons of abundant or above-normal precipitation, this soil produces good yields of all crops. It occurs chiefly in the southern part of the county on the highest and broadest nearly level to undulating upland divides.

CRETE SERIES

The Crete soils are not so uniform as the Butler in all profile features, and they occupy more sloping areas than in counties farther west in the State where they are more typically developed. They have a very dark grayish-brown or nearly black friable fine granular surface soil 10 to 14 inches thick where not thinned by accelerated erosion. In places, a sprinkling of gray silt occurs in the lower part of the surface soil, but this is not discernible except when the soil is in a very dry condition or when it is exposed in a vertical bank. Below this is a 2- to 4-inch dark-brown slightly heavier coarse granular transitional layer that merges with the dark-brown claypan subsoil. The subsoil is compact and heavy in the upper part but gradually becomes lighter colored and more friable with depth, grading into light-brown or grayish-brown massive silty clay loam, which continues to the slightly altered Peorian loess at a depth of about 42 inches. A thin sprinkling of lime concretions is commonly present in the lower part of the subsoil and the loess substratum usually contains finely divided lime carbonate.

The Crete soils are mostly in the central and southern parts of the county and occur on undulating to gently sloping loessal uplands in association with the Sharpsburg and Butler soils. In places they occupy a gently sloping transitional area between the Butler soils on the flat uplands and the soils on the steeper slopes that have developed from glacial till.

Because of their steeper relief in most places, these soils suffer greater loss of moisture through runoff and are more subject to water erosion than most Butler soils; but as a rule, external drainage is only moderate to good and erosion is negligible, except on the steepest slopes where either may be excessive locally. Like the Butler soils, they have slow imperfect internal drainage owing to the imperviousness of the claypan in the subsoil and, for similar reasons are better suited to growing small grains than corn during most years. They require certain measures for controlling erosion and conserving soil moisture if optimum yields are to be obtained, but are considered easily managed and moderately productive of most crops common to the region.

DEEP AND MEDIUM-DEEP FRIABLE SOILS OF THE GLACIAL UPLANDS

The deep and medium-deep friable soils of the glacial uplands, represented by the Carrington and Burchard series, occupy 19.7 percent of the area of the county. These soils have attained about the same stage of development and thickness as those in the deep and medium-deep friable soils of the loessal uplands but have formed in glacial drift instead of loess and contain some sand and gravel, a smaller percentage of silt, and more clay. They are slightly heavier and less pervious than the loess-derived soils and are not so easily farmed. Under comparable management, however, most of them are nearly as productive as any of the more friable soils occupying similar positions on the loessal uplands.

CARRINGTON SERIES

The soils of the Carrington series are characterized by a 12- to 15-inch very dark granular surface layer. The upper subsoil is brown or slightly reddish-brown cloddy moderately heavy, though fairly friable gritty silty clay or sandy clay, merging into lighter brown or gray massive gritty clay of the lower subsoil layer. This in turn rests on the parent Kansan drift, usually at a depth of 30 to 36 inches. In most places the drift is composed of mixed silt, clay, sand, and gravel together with an occasional boulder, the finer textured materials predominating. The solum also contains gravel and scattered boulders, but in most places the coarse material is not abundant enough to interfere with cultivation or to affect either the internal or external movement of moisture. The soils have been leached of free lime in most places to a depth of 3 feet or more, but as yet do not seem to require liming for optimum crop production. They are used for growing the same crops as are produced on the Sharpsburg soils, with nearly as good results, although a slightly larger percentage of their total area is used for growing small grains and sweetclover and less for corn. As with all arable soils of the uplands, crop yields vary chiefly with differences in slope and in the supply of soil moisture, being best on the areas of least relief and having less loss of moisture through runoff.

BURCHARD SERIES

The soils of the Burchard series are developed on rolling to steeply sloping areas of calcareous Kansan drift. They are characterized by a very dark granular friable and moderately deep surface layer and a rather light-colored friable or moderately heavy subsoil, the basal parts of which are highly calcareous. The subsoil merges with limy glacial drift at a depth of 24 to 30 inches. These soils are transitional in development between those of the Carrington and the Steinauer series, differing from the Carrington in being a little less deeply developed and in having an abundance of lime in the lower part of the subsoil, and from the Steinauer in being more deeply developed and in having lower lying lime.

All the Burchard soils are well drained and in some places are subject to rather rapid surface runoff and to moderate water erosion. For highest yields they require considerable care in controlling runoff and conserving soil moisture and organic matter. They are used rather extensively for all cultivated crops common to the area and, where most fully developed, are about as well suited to these crops as are corresponding types and phases of the Carrington soils. They occupy rougher relief, however, than do most Carrington soils, are more subject to water erosion, lose more moisture through runoff, and are therefore less productive as a rule. Nonarable areas support scattered trees and fairly thick stands of tall grasses and are used advantageously for pasture land.

DEEP HEAVY SOILS OF THE GLACIAL UPLANDS

The deep heavy soils of the glacial uplands occupy 8.4 percent of the area of the county. The group includes only the Pawnee series.

PAWNEE SERIES

This series includes a very dark heavy soil developed under a tall-grass vegetation on undulating to gently rolling areas of heavy glacial drift. This soil differs from those soils of the Butler and Crete series mainly in having a little sand and some gravel in the profile and a substratum of drift instead of loess. In general, the slopes have about the same gradient as those on which the Crete soils occur. The Pawnee has a very dark grayish-brown or almost black granular and friable surface soil 8 to 15 inches thick, underlain by a slightly lighter colored silty subsurface layer 1 to 3 inches thick. The upper part of the subsoil, a brown, dark-brown, or almost black dense clay 10 to 20 inches thick, probably owes its degree of consistency or firmness mainly to the character of the parent drift material. It contacts with the layer above abruptly but merges gradually below with the light grayish-brown moderately compact limy clay loam or sandy clay lower subsoil. Both the lower subsoil and the parent drift material are highly calcareous in most places. The subsoil is much heavier throughout than that in the Carrington or Burchard soils.

This Pawnee soil has about the same crop adaptations as the Butler, but generally is the less productive because the relief is not so level. It suffers greater loss of moisture through runoff and requires more erosion-control measures than the Butler. It occurs chiefly in eastern Nebraska, but occupies only small widely scattered areas in the county, mostly in the western part.

SHALLOW FRIABLE SOILS OF THE GLACIAL AND BEDROCK UPLANDS

The shallow friable soils of the glacial and bedrock uplands occupy 3.0 percent of the area of the county and include upland areas of soils in which deep development has been prevented mainly by water or wind erosion and partly by the resistant nature of the parent materials to weathering and soil formation. Soils of the Steinauer, Sogn, Lancaster, and Dickinson series belong to this group. The Steinauer soils are on glacial deposits consisting of a mixture of silt, clay, sand, and gravel, the finer textured materials predominating, whereas in the Dickinson the deposits are composed largely of loose sand. The Sogn and Lancaster soils are on limestone and sandstone bedrock respectively and contain an abundance of stone fragments. Only the Steinauer and Sogn soils of the group have a significant quantity of lime.

STEINAUER SERIES

The soils of the Steinauer series represent the first stage of soil development on limy drift. They differ from those of the Burchard series mainly in having lighter color and a thinner surface soil, a thinner subsoil, and higher lying lime. The surface soil varies considerably in texture, color, and depth but in most places it consists of dark-brown or brown loam 4 to 8 inches thick. Where best developed the subsoil is about 4 inches thick and consists of light-brown or yellowish-brown friable or moderately friable clay loam. In most places it is either a mere transitional layer between the surface soil and the parent drift or is not developed. The drift consists of a mixture of sand, silt, and clay and is exposed at the surface in many places. The soils commonly contain numerous stones and boulders on the surface and throughout the profile and usually are limy at or near the surface and downward.

This series occupies the most dissected parts of the glacial uplands, where the relief is hilly to steeply sloping and runoff is everywhere rapid. Native vegetation consists largely of grass, although scattered trees are on most of the areas. Nearly all areas are either too rough or too stony for cultivation and are best suited to pasture or to hay and timber. They produce a variety of trees and good grass during spring and fall, but in midsummer the grasses usually suffer from drought.

SOGN SERIES

The only soil of the Sogn series is immaturely developed from weathered limestone and limy shale under the influence of a grass vegetation. The shallow surface layer varies from almost black to light yellowish gray, the color being determined by the organic-matter content, which in turn is determined by the severity of erosion. The surface soil ordinarily contains numerous fragments of partly weathered limestone and enough organic matter to make them dark grayish-brown loam or silt loam. The subsoil, where developed enough to be called such, is yellowish-brown silty clay loam. In most places the dark surface soil rests directly on the parent rock within a depth of 6 inches. Exposures of the bedrock are numerous.

This soil contains enough of the essential plant nutrients for all the crops common to the area, but is topographically unsuited to cultivation. It occupies areas of steeply sloping relief, has rapid runoff, and is subject to severe water erosion. The soil suffers such great loss of moisture through runoff and is so shallow that it is not very productive. Trees and grasses thrive during years of abundant precipitation but grasses usually suffer considerably during dry seasons. Most areas still support a cover of native grasses and trees and are used for pasture.

LANCASTER SERIES

In the Lancaster series the single soil is relatively shallow, overlying weathered sandstone commonly of the Dakota formation and is characterized by a dark-brown sandy loam surface layer 4 to 8 inches thick containing considerable organic matter and numerous sandstone fragments. The subsoil, where best developed, is 8 to 10 inches thick and consists of friable fine sandy loam. It varies in color but includes shades and combinations of red, brown, yellow, and gray. In places the subsoil is absent and the surface soil rests directly on the parent sandstone; in other places sandstone outcrops. The depth and color of the soil depends partly on the hardness and the chemical composition of the sandstone bedrock and partly on the dissection and erosion that has occurred during and following its development. This soil varies considerably in depth but in most places is shallow or only moderately deep. It does not contain enough lime to produce visible effervescence when dilute hydrochloric acid is applied, but does not seem deficient in available calcium so far as crop needs are concerned.

The greater part of the Lancaster soil is topographicaly unsuited to farming. In most places it is difficult to manage under cultivation because of the unfavorable relief and the severe losses of organic material through erosion. Drainage is excessive and water erosion is severe in most places. This soil is best suited to early spring grazing land and to the production of timber. Native oak trees and a sparse undercover of tall grasses are in most of the areas. Grasses start quickly in spring but ordinarily dry up in summer, whereas trees generally obtain enough moisture even during the dry season to withstand drought well. Soils of this series occupy small widely scattered rolling to steeply sloping areas chiefly in the eastern parts of Kansas and Nebraska.

DICKINSON SERIES

The only soil of the Dickinson series is developed on gently rolling to steeply sloping areas of deep ice-laid sands and is characterized by a very dark-brown friable surface layer 8 to 12 inches thick, a dark-brown slightly heavier though friable upper subsoil layer of sandy clay loam, and a lower subsoil layer and substratum of incoherent or only slightly coherent fine to medium sand. The soil does not usually contain lime, but locally may be slightly calcareous below a depth of about 4 feet.

Owing to its porous sandy character, this soil rapidly absorbs most of the precipitation, thus allowing very little moisture loss through runoff, but it does not have a high moisture-holding capacity and is unable to supply the crops with as much moisture as the finer textured soils. Where best developed, it is used successfully for growing corn, small grains, and clover, but in most places is too steeply sloping to be well suited to cultivation or has such thin unstable surface soils that it is better suited to growing legumes, native grasses, and trees than to grain.

DEEP FRIABLE SOILS OF THE TERRACES

The deep friable soils of the terraces occupy 5.3 percent of the area of the county and comprise deep friable silty soils on nearly level to undulating well-drained terraces not subject to overflow. They include two units of the Waukesha series. These soils have developed from silty deposits similar to those giving rise to the Sharpsburg of the loessal uplands and do not differ appreciably in profile features from those soils, but occupy terrace positions. In places they have developed partly from water-laid loesslike material washed chiefly from the loessal uplands, but this variation is of minor significance.

WAUKESHA SERIES

In the Waukesha series the surface soil is deep, dark, and finely granular and the subsoil is slightly lighter colored, friable, and well oxidized. Both high and moderately low nearly level to gently sloping well-drained stream terraces are occupied. The higher and older terraces are thickly capped with silt as is most of the upland. The lower terraces, most of which are adjacent to the narrower bottom lands, have been formed since the loess was deposited on the upland.

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They consist of silty materials washed mainly from the adjacent loessal uplands and deposited by streams that were then flowing at higher elevations. The subsoil on the lower terraces is darker than on the high terraces, where the profile horizons are most distinctly developed and where these soils and those of the Sharpsburg series are almost identical. Neither of the Waukesha soils is noticeably limy, but both contain enough available calcium and all other essential plant nutrients for crop needs. At a depth of about 4 feet, the soils on the high terraces rest on silty material similar to that beneath the Sharpsburg soils, whereas those on the low terraces generally are underlain at about that depth by alternating layers of stream-laid sand, silt, and clay.

The Waukesha soils include some of the most productive and valuable land for general farming. The smooth surface favors slower runoff than on most of the well-drained uplands, and the soils on the terraces also receive some supplemental moisture from higher lying areas. Furthermore the underlying water table is within reach of the deeper rooted crops in many places. The soils contain an abundance of organic matter; they are friable and easily penetrated by air, roots, and water; they absorb moisture readily; and they have a high water-holding capacity. They are not subject to destructive erosion, are easily tilled, and can stand severe cropping under rather poor management without serious reduction in yields. They are well suited to any crop common to the region and in nearly all parts are cultivated. Ordinarily, crops yield better on these soils than on the best soils of the uplands because of a greater supply of moisture on the terraces.

DEEP HEAVY SOILS OF THE TERRACES

The deep heavy soils of the terraces occupy 0.5 percent of the area of the county and consist of one type of the Rokeby series. This does not differ significantly from the deep heavy Butler soils of the loessal uplands in profile features but occupies terrace positions where it receives some moisture through runoff from higher land. Because of this it withstands prolonged droughts a little better and is slightly more productive of some crops.

ROKEBY SERIES

The Rokeby series has one of the heaviest soils on terraces in Nebraska. It lies nearly level to very gently sloping and differs from the Butler, which are on the uplands, only in position; and from the Waukesha mainly in having a claypan in the upper part and a horizon of lime enrichment in the lower part of the subsoil. It is stone-free and fine-textured throughout. The surface soil is very dark grayish-brown or almost black finely granular friable silty clay loam 10 to 18 inches thick, underlain by a lighter colored but otherwise similar subsurface layer about 2 inches thick from which a part of the organic matter has been leached. The latter layer rests abruptly on the upper subsoil, a very dark-brown or almost black dense massive claypan. The claypan is 8 to 20 inches thick and gradually merges downward to the lower subsoil, a light-brown or light-gray moderately compact but friable silty clay containing considerable lime in the form of small hard concretions. Silty parent material similar to that beneath the Waukesha soils is about 4 feet below the surface of the ground. The surface soil and upper part of the subsoil are not noticeably calcareous.

Drainage, although slow internally on account of the heavy subsoil, is adequate throughout for all cultivated crops. Ordinarily, most crops yield better on the Rokeby than on the Butler soils because of the greater supply of moisture on the terraces, but the yields average lower than those obtained on the well-drained Waukesha soils that have no claypan and are generally better supplied with moisture. The claypan in the Rokeby does not allow water to penetrate deeply. This causes most of the readily available moisture to be supplied by the surface soil, which is not thick enough to store all the water needed by many crops during prolonged droughts. This soil is used for growing the principal crops common to the area, and in seasons of normal or above normal precipitation it is considered nearly as desirable for such use as the more friable soils of the terraces.

ALLUVIAL AND COLLUVIAL SOILS

The alluvial and colluvial soils occupy 19.4 percent of the total area of the county and include the Wabash, Lamoure, Bremer, and Judson series. All except the Judson soils, which are on colluvial slopes, occur in bodies and strips of various widths on the bottom lands along all the larger and many of the smaller streams. The more extensive areas are along Salt Creek and the lower courses of its principal tributaries. Some of these are more than a mile wide in places. The narrower strips are along the smaller streams and vary from a few rods to about half a mile in width. The Judson soils occur at the base of slopes and at the mouths of small intermittent drains, either on terraces or on valley floors.

Although nearly level, except for a slight slope downstream, where traversed by active and abandoned stream channels, or where modified by slight elevations and shallow depressions, most of the soils in the group have adequate surface drainage. Many of them flood frequently or at least occasionally but most of the surplus water drains away readily from all except the lowest places. In most areas, the water table lies 4 to 15 feet below the top of the ground and the subsoils are kept moist, even during dry seasons.

All the alluvial and colluvial soils are abundantly supplied with organic matter and other essential plant nutrients and all except those most poorly drained and those occupying stream meanders are cultivated. They are best suited to growing corn, alfalfa, and sweetclover and commonly are more productive of these crops than any of the other soils. Small grains grow well but owing to the abundance of organic matter and moisture they generally make a rank vegetal growth at the expense of the grain, mature rather late, and yield less than on the well-drained terraces and uplands. Most of the uncultivated areas support a luxuriant growth of grass and a wide variety of trees and are used advantageously for pasture, hay, and timber.

WABASH SERIES

The soils of the Wabash series are characterized by a 12- to 18-inch very dark or almost black surface layer and an equally dark or only slightly lighter colored subsoil composed largely of silty clay loam.

Thin seams of sandy sedimentary material are not uncommon. Lime is not present in sufficient quantities to react noticeably when the soil is treated with dilute hydrochloric acid, but none of the soils seem deficient in available calcium so far as crop needs are concerned.

The Wabash soils occupy bottom-land areas subject to frequent or occasional overflow and are more extensive than any of the alluvial soils. They are developing from alluvium washed mainly from the adjacent loessal and glacial uplands. In most places they are friable or only moderately heavy; and usually are easily penetrated by air, roots, and moisture. The Wabash soils are among the most productive in the Central Lowland for corn, alfalfa, and sweetclover, and are used chiefly for these crops. They are also used considerably for small grains, but as on most alluvial soils, these crops have a tendency to make a rank growth, mature later, and yield less than on the better drained soils of the uplands and terraces, especially in seasons of normal or above-normal precipitation. Most uncultivated areas include poorly drained localities and areas made difficult to farm by stream meanders. They support a luxuriant growth of grass, with trees along the streams, and provide excellent pasture, hay, and timber lands.

LAMOURE SERIES

The soils of the Lamoure series differ from those of the Wabash mainly in being limy and more poorly drained throughout and in having a lighter colored subsoil and substratum. They consist of stratified layers of fine-textured alluvium and are highly calcareous from the surface downward. In the upper part they are almost black but in the lower part are dark brown to light brown mottled and streaked with brown, rust brown, gray, and yellow. The soil material ordinarily is moderately friable at and near the surface and becomes heavier and more massive with depth, but there is no indication of a claypan in the subsoil. The mottlings, which indicate poor internal drainage, are due chiefly to a high water table and are within 10 or 12 inches of the surface in most places.

Occupying nearly level and rather poorly drained sags and swales on the broad flood plains along the larger streams, these soils are subject to considerable overflow. They usually remain inundated longer after floods than the surrounding soils and commonly are too wet for cultivation unless artificially drained, a practice that often is difficult and seldom economically feasible because of close proximity of the water table and the depressed position of the soils on the bottom lands. The native vegetation consists mainly of tall grasses.

The Lamoure soils have abundant moisture and organic matter and where adequately drained are better suited to corn, alfalfa, and sweetclover than to small grains. Although moderately friable in the upper part, they cannot be worked under so wide a range of moisture conditions as the better drained soils of the bottom lands and require heavier machinery and more power for tillage. Most uncultivated areas support a luxuriant growth of tall grasses and are used advantageously for pasture and native hay.

BREMER SERIES

The single representative of the Bremer series is characterized by a very dark friable surface layer 12 or 15 inches thick underlain by alternating dark and moderately dark sedimentary layers of silt, clay, or silty clay. The subsoil is heavier than the surface soil and in places is moderately compact but there is no claypan. The soil has no free lime but is not deficient in calcium so far as crop needs are concerned. It is so nearly like Wabash soils in profile features that separation from these soils in mapping is based entirely on the more elevated position and consequently greater freedom from overflow.

This soil occupies nearly level areas on the higher parts of the bottom land that are above danger of overflow except possibly during unusually high stages of the streams. Drainage is rather slow but adequate and erosion is negligible. The soil is easily managed, and well suited to cultivation. It is as productive and well suited to growing all the crops common to the area as any of the soils on the bottom lands.

JUDSON SERIES

The soils of the Judson series consist essentially of soil material that has washed or rolled from the dark surface layer of higher lying soil and has accumulated at the base of slopes either on terraces or valley floors and around the mouths of small intermittent drainageways. They are dark and fine- or medium-textured and friable to depths of more than 3 feet. They differ from the Wabash soils mainly in being more uniform in color, texture, and consistence throughout the profile. Their characteristics vary somewhat but there is essentially no change within a given profile to a depth of 3 feet or more. Although not significantly calcareous, they contain enough calcium for all crop needs and have an abundance of organic matter.

All these soils are gently sloping and among the best drained of the lowlands. None is subject to overflow or destructive erosion, except locally. Well supplied with moisture and all essential plant nutrients, they are friable and easily penetrated by air, roots, and water. They are probably the most productive soils in the county but comprise a small percentage of the total land area and are of only local agricultural importance. Like all soils in this group, they are better suited to corn, alfalfa, and sweetclover than to small-grain crops.

In most of the narrow stream valleys, these soils are so intimately associated with soils of the Wabash series that their separate delineation is impracticable, and it is often necessary to recognize Judson-Wabash complexes in mapping. Ordinarily the areas in which these complexes occur are severely dissected by stream meanders and are suitable mainly for pasture, but nevertheless they are important to the diversified farming system commonly practiced. The soils in these areas support luxuriant grasses of superior quality and a wide variety of trees and good pasture during most of the growing season, especially in midsummer, when grasses on the less fertile or more droughty pasture land usually suffer for lack of plant nutrients or insufficient moisture, or both.

DESCRIPTIONS OF SOIL UNITS

Bremer silt loam.—This soil occupies 4,928 acres on high bottoms or very low terraces 4 to 6 feet above the flood plain proper, the largest areas along Salt, Rock, Oak, and Middle Creeks. The land is nearly level, but all areas are adequately drained and are not subject to overflow, except during periods of unusually high water, nor to damaging accelerated erosion.

This soil consists of alternating layers of dark, fine-textured, noncalcareous alluvium and is identical to Wabash silt loam, except for its slightly higher position. Although not noticeably calcareous, the soil contains enough available calcium for all crop needs (pl. 1, *A*).

This type is well adapted to all crops common to the area, and practically all of it is cultivated. The greater part is used for corn and alfalfa, although considerable acreage is planted to wheat and oats. During most years the yields of cultivated crops are about the same as those produced on Wabash silt loam, but in wet seasons when crops on the lowlands proper are damaged by floods, the yields on the Bremer soil are larger. Uncultivated areas support a luxuriant growth of grass and numerous trees and are included in pasture or in hay or timberland.

Burchard clay loam.—This soil occupies 13,504 acres on calcareous drift in areas of rolling to steep land where most of the slopes are 5 to 10 percent. Both surface and internal drainage are good to excessive, and, in most places, especially on the steepest slopes, runoff is rapid and water erosion is severe. Drainageways are numerous and most of them are too deeply entrenched to be crossed with farm machinery.

Though similar in most respects to the rolling phase of Carrington silty clay loam, it contains lime in the lower part of the subsoil, has a slightly shallower lighter colored solum, and contains more coarse material. In most places the 6- to 12-inch surface layer is friable, dark grayish brown, or almost black. Locally this layer contains considerable sand and numerous small stones and pebbles, but the prevailing texture is clay loam. The upper part of the subsoil is dark-brown or brown friable or moderately friable silty clay loam about 8 inches thick that is a little more clayey and slightly more compact than the layer above but has enough sand and gravel to prevent extreme compaction and to facilitate easy penetration of air, roots, and moisture. The subsoil gradually becomes coarser and lighter colored with depth, and consists of brown or light-brown limy sandy clay loam in the lower part. It merges with the parent drift, composed of a limy mixture of sand, silt, clay, and gravel, at 24 to 30 inches below the surface.

The soil has enough of the essential plant nutrients for the growth of all crops common to the area and the greater part of it is cultivated. Where most deeply developed and properly managed, it is nearly as productive of these crops as the rolling phase of Carrington silty clay loam. Most of it, however, has greater relief, is more severely eroded (pl. 1, *B*), loses more moisture through runoff, and is much less productive, especially of corn and small grains, than typical Carrington silty clay loam. All of it, however, is moderately well suited to growing trees and native grasses, and a part of it is included in pasture and farm woodland.

The present cropping and land-management practices are about the same as those followed on soils less subject to erosion, but the soil is naturally more difficult to farm owing to its sloping relief and its susceptibility to serious water erosion during seasons of abundant precipitation when crop yields should be highest. Much more care in soil and moisture conservation than is being exercised at present is required in all areas if satisfactory yields of cultivated crops are to be obtained.

On the more steeply sloping areas, care must be taken not to overgraze the pastures because the soil rapidly loses its dark surface layer and becomes severely eroded and gullied when the protective vegetal cover is destroyed.

The principal variations in this soil are in close association with the Steinauer and Carrington soils. Near areas of Carrington soils, the upper layers of Burchard clay loam are usually a little darker and thicker than common, and the lower part of the subsoil is not highly calcareous. Near areas of Steinauer soils, the Burchard is less dark at the surface, is shallower, and has lime nearer the top of the ground than usual.

Burchard clay loam, hill phase.—This phase occupies 3,392 acres on steep slopes in association with the typical soil, the slopes of most areas being 10 to 15 percent. Surface drainage is rapid and internal drainage medium to good. Under continuous cultivation and in an overgrazed condition, the soil is subject to serious water erosion.

The surface soil is thinner and the calcareous subsoil lies at a shallower depth than in the typical soil; otherwise, the two soils are nearly identical. The soil supports a grass cover equally as good in quality as the typical soil, but it does not have so high a carrying capacity. Only a small acreage is cultivated, and crop yields are usually low. All the soil should be reseeded to permanent grass for best long-time returns and to prevent serious erosion.

Butler silty clay loam.—This soil occupies 12,416 acres chiefly in the southern part of the county on the broadest and smoothest parts of the loessal uplands, where slopes are generally less than 2 percent. In places the soil may slope more than this and where it does the subsoil resembles that of Crete silty clay loam. Surface drainage is rather slow but is sufficient to remove all surplus water. Internal drainage is slow and imperfect, owing to the compact character of the subsoil. Erosion is negligible in most places. Much fine material from the surface layer has been carried downward by percolating waters and deposited in the upper part of the subsoil to produce a true claypan that absorbs and releases water very slowly.

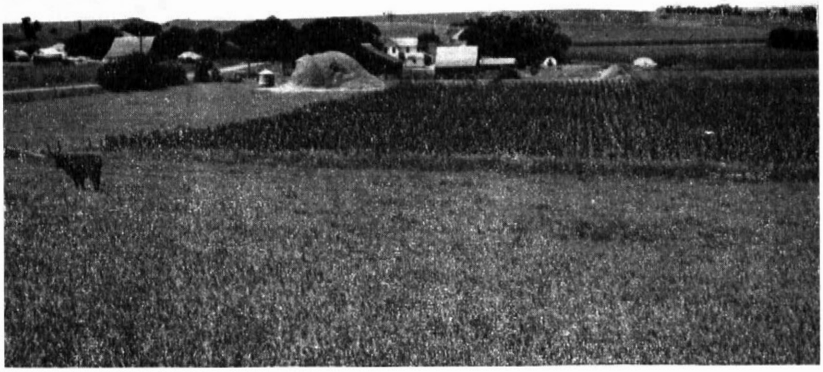
The surface soil is dark grayish-brown or nearly black fine-grained silty clay loam having an average depth of about 16 inches. In many places its 3- or 4-inch lower layer contains many particles of light-gray silt from which the organic matter has been leached. Although very dark when moist, this layer when dry has a somewhat lighter shade than the overlying material. Beginning abruptly beneath the surface soil is a layer of dark-brown or almost black heavy massive clay 10 to 14 inches thick that is a true claypan. None of the surface soil or of the upper part of the subsoil is noticeably calcareous. The lower part of the subsoil consists of grayish-brown limy moderately heavy silty clay or silty clay loam. Its lime came mostly from the layers above, having been carried down by filtering waters and deposited in root and insect cavities, generally in the form of small hard concretions. The soil rests on light grayish-brown or yellowish-brown slightly oxidized and floury silt of the parent Peorian loess at a depth of about 4 feet. The loess may or may not be slightly calcareous.

All crops common to the general area are grown on this soil but small grains, which mature early in summer mainly on moisture stored near the surface of the ground, do better than corn, which requires moisture for a longer period (pl. 1, *C*). The dense claypan layer in the subsoil holds little moisture that is available to plants, and when the moisture in the surface soil is depleted crops generally suffer from drought, consequently successful crop production depends largely on the conservation of moisture in the surface soil. During seasons of normal or abundant precipitation, all crops yield nearly as well as on the more friable soils of the loessal uplands, but in dry years they usually suffer from drought. Long-time yields of moist crops commonly grown in the county are 10 to 20 percent lower on this soil than on Sharpsburg silty clay loam. Although mostly cultivated at present, the poorly drained areas should be seeded with grasses and used as permanent hay land. It is difficult to use most of these areas as pasture, because they are usually isolated in cultivated fields of more desirable farming land.

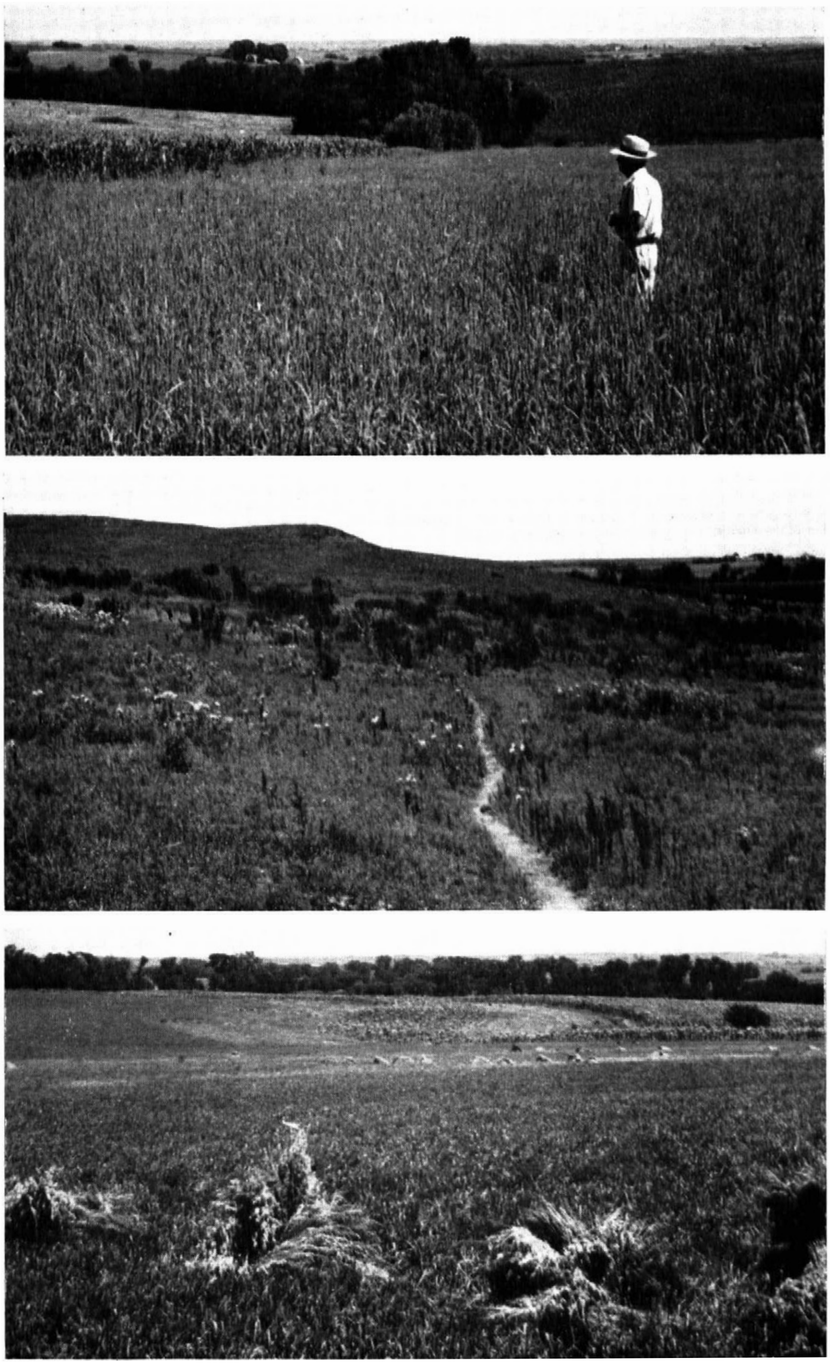
On the broad divide in the vicinity of Princeton a few shallow basin-like areas or depressions occur in areas mapped as Butler silty clay loam in which the soil resembles Scott silty clay—a soil commonly mapped in what is locally known as "buffalo wallows" or lagoons. These areas, however, are of such minor importance agriculturally that their delineation on the soil map is not justified. Their combined area is only a few acres, and they are all too wet for cultivation. Water accumulates in them after rains, and, at times, remains for several weeks before disappearing slowly through seepage or evaporation. Here the surface soil is much finer than common and is considerably leached in the lower part. The rest of the profile is similar to that of the typical soil. That the surface soil contains more clay than occurs in the corresponding part of most of the other Butler soils is well demonstrated in fields including both soils. If such fields are cultivated as soon after rains as moisture conditions in the Butler soil become favorable, the associated soil invariably puddles, bakes, becomes cloddy, and loses an excessive quantity of moisture through evaporation. The same relation exists between the Butler and Sharpsburg soils, but to a less marked degree.

Carrington loam.—This soil occupies 4,096 acres on gently sloping to undulating glacial uplands where most of the gradients are 2 to 5 percent. Both surface and internal drainage are good and, except in a few places on the steeper slopes where runoff is moderately rapid, the soil has not been damaged seriously by water erosion.

The 10- to 12-inch surface layer consists of very dark or almost black friable granular loam or sandy loam, having an abundance of organic matter. The surface layer in places contains numerous small stones and sufficient sand or gravel to make it a little coarser than a loam, but areas having this textural variation are not large enough to justify separate recognition on the soil map. The rest of the profile is almost identical with that of Carrington silty clay loam, except that the sand and gravel content of its lower layers is a little more variable. The subsoil becomes increasingly lighter colored with depth, is friable or moderately so, and is easily penetrated by air, roots, and moisture. The parent drift is a mixture of sand, silt, clay, and gravel; the finer textured materials predominating. Lime does not occur within a depth of 3 feet, except locally.



A, Homestead on Bremer silt loam SE¼ sec 29, T. 10 N., R. 5 E. *B*, Good crops of bromegrass grow on eroded sloping areas of Burchard clay loam Corn in background is on Carrington clay loam *C*, Level area of Butler silty clay loam used for small grain and corn. Corn produces well in normal years, but the claypan subsoil prevents carrying the crop over long droughty periods



A, Big bluestem grass on Carrington loam, rolling phase, near center of sec. 34, T. 9 N., R. 5 E. *B*, Weedy pasture on Lancaster sandy loam in SE¼ sec. 30, T. 10 N., R. 5 E. Brown sandstone outcrops on knolls and hillsides. The soil will produce good pasture with good management. *C*, Contour cultivation on Sharpsburg silty clay loam in western part of county. Crops shown are bromegrass, alfalfa, and corn. Corn in front of trees in upper right-hand part of picture is on Carrington loam. Contour cultivation and use of close-growing crops help to reduce the rate of soil erosion.

Practically all this soil is cultivated and used mainly for corn, followed in acreage by wheat, oats, and alfalfa. Yields are about one-third less than on Carrington silty clay loam. Because of the higher sand and lower clay content of its surface layer, the loam type can be cultivated under a slightly wider range of moisture conditions than the clay loam type and can absorb the precipitation a little more rapidly. In most places it contains more stones in the surface layer than occur in the corresponding layer of the silty clay loam and this increases the maintenance expense on tillage implements used for farming it. The more gravelly areas are usually included in pasture land, and they support considerable tall grass and numerous bur oak trees.

The principal variation in this soil, aside from slight local differences in the texture of the surface soil and subsoil, are in close association with Burchard or Steinauer soils. In these localities the parent glacial drift may contain small quantities of free lime within a depth of 3 feet, but such areas are of small extent. The soil as mapped includes also a few small areas in which the surface of the ground is thickly strewn with gravel.

Carrington loam, rolling phase.—This rolling phase occupies 8,832 acres on the well-drained glacial uplands in areas that are intermediate in relief between the normal type and the steep phase. This phase differs from the typical soil mainly in having greater relief, and, from the rolling phase of Carrington silty clay loam, in that it contains more coarse material or sand and gravel in the surface soil. The slopes are of simple and complex pattern, and the gradients are between 5 and 10 percent. Both surface and internal drainage are good and in some places the former is excessive, causing moderate to severe water erosion. Gullies usually are more frequent and deeper than in areas of the typical soil, but most of them can be crossed with all types of farm machinery.

The surface soil averages about 3 inches thinner than that of the typical soil in most places, but it remains dark and is friable. On the steeper slopes and near gullies, much of it has been removed but, as a whole, the soil has not been damaged seriously by water erosion. The subsoil is almost identical with that of the typical soil and merges with the parent glacial drift at a depth of 26 to 30 inches below the surface.

Nearly all the soil is used for crops common to the area (pl. 2, *A*). Moderately productive, the yields are 10 to 30 percent lower than on the undulating to less rolling normal type, mainly because of a greater loss of moisture through runoff from the more sloping land. Present cropping and land-management practices are similar to those on the other soils of the well-drained uplands, but better yields can be obtained if considerably more care is taken in controlling water erosion and conserving soil moisture.

Carrington loam, steep phase.—This steep phase occupies 11,136 acres in hilly areas of the glacial uplands where most of the slopes are 10 percent or more. It occurs on areas of greater relief and is shallower than most of the typical soil and differs from the steep phase of Carrington silty clay loam chiefly in having a coarser textured surface layer. All of it has good to excessive drainage, but much of it has suffered serious erosion.

The surface soil and subsoil are thinner than in the Carrington soils of smoother areas, chiefly because of a greater loss of soil material through erosion. Except in virgin areas, the surface soil is rarely more than 8 to 10 inches thick. In many places the subsoil is exposed at the surface. The parent drift is commonly at a depth of about 26 inches or less and is similar to that of the other Carrington soils. The soil is similar to Burchard clay loam except that it rarely has any free lime.

Most of this soil is used for the same grain and hay crops as produced on the steep phase of Carrington silty clay loam with about the same results. The continued production of cultivated crops is undesirable because of the difficulty and expense involved in conserving an adequate supply of moisture and organic material on the steep slopes. The soil should be kept in pasture or woodland the greater part of the time and when used for cultivated crops the rotation system should include a large acreage of alfalfa, sweetclover, grasses, or small grains and as small an acreage as possible of row crops. Under the present system of management sheet erosion is becoming serious and injurious gullies, a few of which cannot be crossed with farm machinery, are developing in many places.

Carrington silty clay loam.—This soil type occupies 18,240 acres chiefly in the west-central and northwestern parts of the county on gently undulating well-drained glacial uplands where most of the slopes range from 2 to 5 percent. Numerous included areas have less than 2-percent slope and some have a slope exceeding 5 percent but they are too small and unimportant agriculturally to justify separate delineation on the soil map. Where the slopes exceed 5 percent over significant acreages, a slope phase of Carrington silty clay loam is mapped. Although the slope range is the same as that of Sharpsburg silty clay loam, the areas of Carrington soil, as a whole, are a little more sloping than those of the Sharpsburg. Both surface and internal drainage are moderate except in a few places where runoff is rather rapid.

The 10- to 14-inch surface soil is very dark grayish-brown or almost black friable and granular silty clay loam, containing an abundance of organic matter. In places it has been thinned somewhat by water erosion, but in most places, sheet erosion has been negligible. Ordinarily a few sand grains and small pebbles are scattered over the surface. In places occasional gullies have developed but practically all of them are short, shallow, and can be crossed with most types of farm machinery. The upper part of the subsoil is dark-brown moderately compact gritty silty clay loam, which becomes increasingly lighter colored and more clayey with depth but is fairly friable and rather easily penetrated by air, roots, and moisture. It rests on the lime-free upper part of the Kansas drift at about 30 inches below the surface. The transition in color and consistence between the different layers of the soil section is very gradual and indicative of regional soil development. Although shown on the map as having the same texture as the loess-derived soils, this type naturally contains less silt and more fine sand and clay in the surface layer than any of the soils derived from loess.

This soil absorbs moisture fairly rapidly, has a high water-holding capacity, and contains an abundance of the essential plant nutrients, especially organic matter. Practically all of it is used for grain crops and legumes common to the area with good results. During seasons of normal or abundant precipitation, the crop yields are almost as high as those produced on Sharpsburg silty clay loam, but during the drier years they are slightly lower. The soil absorbs water less readily than does the Sharpsburg soil, has slightly greater relief, and thus suffers greater loss of moisture through runoff.

Cropping and land-management practices are similar to those followed elsewhere in the area. As on most soils, yields depend largely on conservation of the moisture supply through proper management. The slightly greater relief, the higher clay content and slower absorbing rate of the soil make moisture-conservation practices a little more difficult than on Sharpsburg silty clay loam, but the soil is considered easy to manage and ranks among the best for general farming. It can stand rather severe cropping under ordinary management without serious reduction in yields.

The principal variations are in places where the soil is closely associated with the Pawnee, Burchard, or Steinauer soils. The upper subsoil layer near the Pawnee soil, although otherwise unchanged, contains a little more clay and is slightly more compact than normal. Where the soil joins the Burchard or Steinauer soils, small quantities of free lime may be within a depth of 3 feet. Locally, where shallow remnants of either or both of the Loveland or the Peorian loess caps remain—where the total depth of loess over the drift ranges from a few inches to about a foot—part of the solum may contain less sand and graval than common, especially if the associated material is mostly Peorian loess, or it may be slightly reddish brown, if the Loveland predominates or has had sufficient influence. Areas in which all these variations occur are too small and unimportant agriculturally to separate on the soil map. Corn grown on the reddish-brown spots shows marked phosphorus deficiency.

Carrington silty clay loam, rolling phase.—The rolling phase differs from the typical soil mainly in having less even relief. It occupies 42,368 acres on well-drained glacial uplands in areas where the relief is almost identical to that of the rolling phase of Sharpsburg silty clay loam. The land slopes in all directions and gradients range mostly between 5 and 10 percent. Both surface and internal drainage are good, and in some places the former is excessive, causing moderately severe water erosion. Gullies are more frequent and deeper than in areas of the typical soil, but most of them can be crossed with all types of farm machinery.

The surface layer is about 3 inches thinner than that of the typical soil, but it is very dark, coarsely granular, and friable. On the steeper slopes and near gullies, much of the dark upper layer has been removed, but the soil has not been seriously damaged by sheet water erosion. The subsoil is almost identical to that of the typical soil. It merges with the parent drift 26 to 30 inches below the surface.

Nearly all of this soil is used for crops common to the area. It is very productive, but the yields on it are about one-third lower than those produced on the more nearly level Carrington soils, chiefly because of the greater loss of moisture through runoff from the more sloping land. Cropping and land-management practices are similar to those on the rest of the well-drained uplands, but considerable care is required in controlling water erosion and conserving soil moisture if optimum yields are to be obtained. When properly managed, this soil is nearly as productive as the rolling phase of Sharpsburg silty clay loam.

Carrington silty clay loam, steep phase.—This steep phase occurs in close association with the other silty clay loam soils of the Carrington series. It occupies 4,288 acres in areas of hilly to steeply sloping glacial upland where most gradients are 10 percent or more. It has greater relief than areas of the typical soil, is subject to more rapid runoff, and has suffered more serious erosion under the prevailing farming practices. Gullies are frequent and many of them cannot be crossed by tillage machinery.

In most places the surface soil is as dark as that of the other Carrington soils and is granular and friable throughout, but it is thinner, being only about 8 inches thick. The subsoil and the parent material are typical of the Carrington series in all of their physical properties. The reduced thickness of the surface layer reduces to an equal extent the total thickness of the profile that rests on the parent drift at a depth of about 26 inches. The soil closely resembles the steep phase of Burchard clay loam, but it has no free lime in the subsoil or in the upper part of the parent drift.

Most of this soil is used for corn, wheat, oats, sweetclover, and red clover, in acreage in about the order named, but it is not well suited to the continuous production of cultivated crops because of the unfavorable relief, the erosion hazard, and the excessive loss of moisture and soil material through runoff. The more progressive farmers attempt to keep it in permanent pasture or woodland to which it is best suited.

The principal variations are those caused by differential water erosion. In numerous small areas on the steeper slopes of cultivated fields all the dark surface layer has been removed and the brown subsoil is exposed. In other places the surface soil, although still very dark, is only 4 or 5 inches thick and the profile is limy below a depth of about 24 inches. These variations are important locally but are not extensive enough individually to justify separate recognition. Areas in which they occur are included with Carrington silty clay loam, steep phase, on the soil map.

Crete silty clay loam.—This soil type occupies 51,712 acres mostly in the central and southern parts of the county on undulating or gently sloping loessal uplands where most of the gradient is 2 to 5 percent. The slopes may be more than 5 percent, but where such conditions occur over significant acreages the soil is mapped as Crete-Sharpsburg silty clay loams because of the inclusion of a certain quantity of the Sharpsburg soil in delineating the Crete soils on the steeper slopes. It has medium to good surface drainage but runoff is not sufficiently rapid to cause more than slight to moderate water erosion in any locality. Internal drainage is slow. Drainageways are more numerous than in areas of Butler soils but most of them are shallow and can be crossed at all places with heavy farm machinery.

The dark surface layer is deep and has all the characteristics of the Butler soils, except the gray layer in the lower part that is not so pronounced or may not be present. The subsoil is brown or dark brown and dense in its upper part and becomes lighter colored, limy, and more friable in the lower part. The parent loess generally is not calcareous. This type is similar to Butler silty clay loam in most profile features, but its subsoil is a little more friable and not so dark as that of the Butler soil.

Nearly all areas are cultivated. The soil is almost as well suited to the main crops common to the area as is Butler silty clay loam, but it produces slightly lower yields of most crops than that soil because of the greater loss of moisture through runoff from its more sloping surface. Alfalfa and sweetclover, however, yield about as well on this soil as they do on the Butler soils. As with the Butler soils, crop yields depend mainly on the supply and conservation of moisture in the surface soil, which is determined by the quantity and distribution of the precipitation and by tillage methods, the latter probably being more significant during most years.

A few small areas occupy terraces along the larger streams. Most of these are on gentle slopes leading from the terraces to the flood plains. If they were more numerous or of larger total acreage, they would have been mapped as a terrace phase of Crete or given a separate name. The soil on the sloping edges of the terraces does not differ greatly from Crete silty clay loam in any of its principal profile features.

Crete-Sharpsburg silty clay loams.—This complex occupies 37,888 acres on single slopes in close association with Crete silty clay loam. The slopes, ranging from 5 to 7½ percent in most places, may vary slightly but the land, within most areas, slopes in only one direction instead of in several. The soil has medium to rapid surface drainage and, in places, is subject to moderate erosion. Internal drainage is medium to slow.

In most places, the soils included in this mapping unit are similar to but a little more variable than those of the Crete series. The included Sharpsburg soil is fairly typical of much of Sharpsburg silty clay loam in southeastern Nebraska, but as a whole it has a more compact subsoil. The principal variations in the profile are in the depth of the surface layer and in the consistence of the heavy subsoil. On some of the steeper cultivated slopes, the surface layer has been thinned somewhat through water erosion and is only 6 to 10 inches thick. In places near the base of slopes this complex is underlain by glacial drift at a depth of 3 or 4 feet. In these localities the moisture supply is increased somewhat by seepage water from the contact between the loess and drift, but the total area in which this condition occurs is also too small to justify recognition on the map.

Nearly all of the soil is used for growing the cultivated crops common to the area. The uniformity and single direction of the slopes on which it occurs makes contour farming, terracing, and other farming practices designed to conserve moisture, easier to apply, and more efficient than on soils having complex slopes; but moisture conservation is not practiced to a great extent, and most yields do not differ significantly from those obtained on Crete silty clay loam or the rolling phase of Sharpsburg silty clay loam.

Dickinson sandy loam.—This soil type occupies 640 acres on slopes of 5 to 15 percent, although a few small areas occur where the gradient is slightly less or more than 20 percent. The soil has developed from local deposits of sand left in their present positions by the Kansan glacier. Later accumulations of organic matter have given the sandy deposits dark surface layers, and the downward movement of the finest soil particles has produced a slightly heavier though friable upper subsoil layer. Drainage is good to excessive and water erosion is negligible, because of the porosity of the soil and soil material.

Where least disturbed by wind erosion, the surface soil consists of dark grayish-brown friable sandy loam 8 to 10 inches thick. The upper part of the subsoil is dark-brown or brown fine sandy loam or sandy clay loam about 14 inches thick. The rest of the profile becomes increasingly loose and more sandy downward, consisting of incoherent gray sand below a depth of about 4 feet. Gravel and small pebbles are usually scattered over the surface of the ground and throughout the soil. Any lime that the parent sandy deposits may have contained has long since been removed.

The principal variations are on the steepest slopes and narrowest ridge tops in the cultivated fields, where the greater part of the organic material has been removed from the surface layer, either partly by wind or by water erosion. In these localities the soil is light colored and quite sandy from the surface downward, and in places, either the subsoil or substratum is apparently exposed.

This soil is friable and can be worked under a wide range of moisture conditions. Except locally, it contains enough of the essential plant nutrients to grow any crop common to the area and, during seasons of abundant rainfall, produces average yields of most crops; but during most years it is unable to store enough moisture for optimum plant growth, especially of grain crops, and yields are considerably less than those obtained on the less sandy soils of the uplands. Alfalfa and sweetclover, the roots of which penetrate to deep-seated moisture, do well during most years. As a whole, the soil is best suited to spring grazing land and to the production of alfalfa hay and trees. It warms earlier in spring than the finer textured soils, and grasses supply good early pasture but generally suffer during summer from a lack of moisture. All trees common to southeastern Nebraska do well.

The chief need of the soil is a permanent vegetative cover, because the strong summer winds and the downward penetrating waters remove much of the organic material from the surface soil when the protective vegetative cover is destroyed. Care should be taken not to overgraze the pastures.

Judson silt loam.—This soil type occupies 832 acres in small areas widely scattered throughout the county. It consists of almost black surface-soil material that has washed or rolled down from higher levels and has accumulated as fanlike deposits at the base of slopes and in the broader valleys near the mouths of small drainageways. Most of the areas are nearly level except for a slight slope toward the stream. Drainage is good and erosion is negligible.

To a depth of more than 3 feet this soil is dark grayish-brown or almost black friable finely granular silt loam, light silty clay loam, or very fine sandy loam. The silt loam predominates. No free lime occurs in any part of the profile.

The high water-holding capacity and the abundant supply of well-decomposed organic material makes this soil easily farmed and more productive of all crops common to the area than any other soil in the county. It is practically all cultivated, but because of its small extent, is of minor agricultural importance. In common with other soils of the lowlands, it is better suited to corn, alfalfa, and sweetclover than to small grains. Local uncultivated areas supporting thick stands of grass and numerous trees are used for pasture, native hay, and timber.

Judson-Wabash fine sandy loams.—This soil complex occupies 1,728 acres in the county, mostly on the floors of narrow stream valleys. It includes Judson fine sandy loam and Wabash fine sandy loam in areas too small and intricately associated to justify separate recognition on a map of the scale used in this survey. The Wabash soil is almost identical with Wabash fine sandy loam as described, whereas the Judson soil differs from Judson silt loam only in having a little more sand throughout its profile.

The soils of this complex are as well suited to all crops common to the area as are any of the soils on the bottom lands or colluvial slopes. They warm earlier in spring, have a slightly greater water-absorbing capacity, and can be worked under a wider range of moisture conditions with less power than can any of the finer textured soils but are no more productive. Most of the areas are in such narrow strips and are so dissected by stream meanders that they are suitable only for pastures or for hay and trees. Some cultivated areas are used successfully for truck and garden crops but are only of local importance because of their small extent.

Judson-Wabash silt loams.—This soil complex occupies 15,168 acres in numerous narrow valley floors where both Judson silt loam and Wabash silt loam are intricately associated in small patchy areas. Each soil is almost identical to its respective type as described and both have such similar surface features, drainage conditions, and land use suitabilities that their separate delineation on the soil map is not justified.

The soils are as productive as any in the county, but they occupy areas so narrow and so severely dissected by stream meanders that they are difficult to cultivate and are used mainly for pasture, hay, and trees.

Lamoure silty clay.—This soil type occupies 2,944 acres, mostly in nearly level imperfectly or poorly drained situations on the broad bottoms along the larger streams, and is subject to considerable overflow. In places it is artificially drained, but most of it lies too low for such practice and remains inundated longer than the surrounding land.

The 12-inch surface soil is almost black heavy silty clay, except in a few places where its upper 2- or 3-inch layer has been lightened in color by gray and yellow silt recently washed from the uplands. The rest of the profile consists of alternating layers of dark-brown and light-brown or gray silty clay or clay and is more massive than the layer above but has no claypan characteristics. It contains numerous gray, yellow, brown, and rusty-brown streaks, spots, and splotches indicating poor internal drainage. The soil is limy at or near the surface and downward.

Where adequately drained this soil is as well suited to all crops common to the area as most Wabash soils, but most of it is too wet for cultivation and remains in pasture or hay land. The virgin areas support thick stands of tall nutritious grasses.

Lamoure silty clay, saline phase.—This saline phase occupies 3,968 acres in flat, poorly or imperfectly drained depressions on the broad flood plains chiefly along Salt and Rock Creeks. It differs from the typical soil mainly in having an appreciable quantity of salt in its surface layer, and from the saline phase of Wabash silty clay chiefly in being limy throughout and in having a slightly lighter colored subsoil and substratum. Most of the soil is subject to frequent overflow and to prolonged inundation.

The salts are principally in the upper 10- or 12-inch layer and consist chiefly of chlorides and sulfates of sodium and calcium and also some sodium carbonate in places. The soil is too wet and salty for cultivated crops and is used for pasture and hay. It produces mainly saltgrass and western wheatgrass, which provide feed of medium quality for livestock.

Lancaster sandy loam.—This soil type occupies 576 acres in small and widely scattered areas throughout the county, where it has developed on Dakota sandstone. Only the larger areas are recognized in the survey. Those too small to be shown accurately on the soil map are indicated by rock outcrop symbols and are included with other soils. The land is either strongly rolling or occupies slopes of 10 percent or more except in places on or near the tops of well-rounded ridges, where the gradient is only about 5 percent. Water runoff and erosion are excessive.

The surface layer varies considerably in color and depth, but commonly it is dark-brown sandy loam less than 8 inches thick. Except locally, it contains numerous fragments of partly weathered sandstone and a moderate quantity of organic matter. Its color depends mainly on organic-matter content, severity of erosion, and composition of parent material. In places it is rusty brown or reddish brown, owing to the high percentage of iron in the parent formation. The subsoil, where best developed, consists of reddish-brown sandy clay loam about 10 inches thick. It has a gritty feel when wet and is rather hard and brittle when dry but friable under most moisture conditions. Below the subsoil is reddish-brown sandstone. Neither the soil nor the parent sandstone is limy. In many places the surface soil rests directly on the sandstone and, in numerous small patches, the bedrock is exposed. The depth of the soil depends partly on the density of the sandstone and its resistance to weathering but mainly on how much erosion has occurred.

Topographically unsuited to cultivation in most places, nearly all of this soil is used for pasture and woodland (pl. 2, *B*). Most of it supports a fair cover of grasses and scattered bur oak trees. Care should be taken not to overgraze the pastures, as when the vegetative cover is destroyed the soil suffers severe losses of organic matter through wind and water erosion.

This soil is more susceptible to water erosion than any of the other drift-derived soils owing to its impervious nature and, since most of it is quite sloping, it has suffered considerably from both the sheet and gully types of water erosion.

Pawnee silty clay loam.—This soil occupies 45,248 acres on the undulating to gently sloping glacial uplands, chiefly in the central and southern parts of the county. Most of it is in small scattered areas on slopes of 5 to 8 percent. Surface drainage is good throughout and in many places on the steeper slopes runoff is sufficient to cause severe sheet erosion. Drainageways are numerous and a little gullied, but nearly all of them can be crossed in places with all types of farm machinery. Internal drainage is practically stopped by the heavy upper layer of the subsoil.

On mildly sloping uneroded areas, the 8- to 12-inch surface soil consists of dark-gray or almost black friable granular silty clay loam. In places, the basal 2- or 3-inch part of this layer is more leached of its organic matter than the rest and is lighter colored or gray. In most places the surface soil, having lost much silty material through runoff and water erosion, is clay loam and is much shallower here than in the normal phase. The 10- to 14-inch upper part of the subsoil consists of brown or grayish-brown dense massive clay containing enough sand to give it a gritty feel. It is almost impervious to moisture and greatly restricts air and root penetration. The transition between the friable surface soil and the dense subsoil is very abrupt. The lower part of the subsoil is light-brown or yellowish-brown moderately compact gritty clay loam containing numerous small hard lime concretions. At a depth of 3 or 4 feet this layer rests on glacial drift similar to that beneath the Carrington soils, except that it is generally calcareous. In all areas of the soil, gravel, pebbles, and occasional boulders may occur at or near the surface and be numerous in the lower part of the subsoil or parent drift.

This soil differs from Burchard clay loam and Carrington silty clay loam mainly in having a clayey and compact upper subsoil. It also differs from the Carrington soil in having lime in the lower part of the subsoil and parent drift. Downward-percolating waters have been unable to penetrate the heavy upper subsoil and remove the lime from the lower subsoil and parent drift material. It closely resembles Crete silty clay loam but has more sand and gravel and less silt in the solum and a substratum of heavy glacial drift instead of floury loess.

Most of this soil is used for crops common to the area. Corn occupies the largest acreage, followed by oats, wheat, and alfalfa in about the order named. The soil contains essential plant nutrients, but yields of most crops are only slightly more than half those obtained on Butler silty clay loam because of the greater loss of moisture and organic matter through runoff. In places on the steepest slopes these losses usually are sufficient to cause serious reduction in crop yields, especially corn. For optimum yields, greater care should be exercised in controlling runoff than is now practiced by most farmers. Proper management should include contour farming and strip cropping with legumes and small grains. Eroded areas should be seeded to permanent pasture and care taken not to overgraze them and destroy the protective sod.

The principal variation in this type is on slopes where it is in close association with the Crete or Butler soils. In places it is difficult to separate the Crete and Pawnee soils and it is necessary to draw arbitrary lines. As a result many small areas of Crete silty clay loam, too small and unimportant agriculturally to map separately, are included with the Pawnee soil.

Rokeby silty clay loam.—This soil type occupies 2,880 acres on the more nearly level parts of both the high and low terraces or benches, generally in areas of less than 2-percent slope, and is most extensive on the higher loess-capped terraces. Its surface drainage is slow but adequate in most places, and internal drainage is very slow owing to an almost impervious layer in the subsoil. The soil occupies slight depressions and rather poorly drained sags, but none of it is considered too wet for cultivation. It loses little moisture through runoff and has not been damaged appreciably by erosion.

On the higher terraces this soil, except for its lower position, is almost identical with Butler silty clay loam. It differs from Waukesha silty clay loam mainly in having a claypan in the upper part of its subsoil and a zone of lime enrichment in the lower part. The surface layer is dark grayish-brown finely granular silty clay loam about 16 inches thick, containing enough organic matter to be mellow and to facilitate moderately rapid moisture absorption. Ordinarily, the lower 2- to 4-inch part of this layer is noticeably lighter in color than the rest because of the removal of part of the organic matter through leaching. The upper subsoil layer, or the claypan, contacts the surface soil abruptly and consists of very dark grayish-brown compact clay 10 to 16 inches thick. The lower part of the subsoil is grayish-brown friable or only moderately compact clay loam containing scattered small hard lime concretions. This layer continues to a depth of about 48 inches where it merges with the parent Peorian loess, which commonly is not calcareous. On the lower terraces, the basal part of the subsoil is darker than on the high terraces, and the substratum below a depth of 4 feet usually consists of alternating layers of noncalcareous stream-laid sand, silt, and clay.

This type contains the essential plant nutrients and can stand severe cropping over long periods without serious reduction in yields. Practically all of it is used for any of the crops common to the area. Yields are similar to those on Butler silty clay loam. The claypan restricts deep root development, and the surface soil is unable to store enough moisture to sustain crops during prolonged droughts. As on all the claypan soils, small grains do better than corn. Alfalfa does about as well as on the more friable soils of the uplands and terraces, because its roots are able to penetrate the claypan and obtain the deeper seated moisture.

This soil is easily cultivated and in most places has sufficient slope to carry off surplus water, but it cannot be worked so early in the spring or so soon after heavy rains as the more friable soils because of the relative impermeability of its subsoil. During seasons of above normal precipitation the injurious effects of the claypan are greatly reduced and the soil produces almost as high yields of most crops as are obtained on Waukesha silty clay loam.

Sharpsburg silty clay loam.—This, the most extensive soil in the county, occupies 90,432 acres on nearly all parts of the loessal uplands, mostly on slopes of 2 to 5 percent. In places the land slopes a little more or less than these percentages, but where the variations occur over significant acreages either a level phase or a rolling phase of this type is indicated on the soil map. Both surface and internal drainage are good. Except locally, runoff has not been sufficiently rapid to cause appreciable erosion.

The surface layer consists of mellow finely granular silty clay loam that contains an abundance of organic matter and works easily under a fairly wide range of moisture conditions. It is very dark when dry and is almost black when wet. Normally it is 12 to 16 inches thick but locally its thickness has been reduced slightly by erosion. In places, a few short shallow gullies have developed. The upper part of the subsoil is dark grayish-brown moderately compact silty clay loam, containing a little more clay and is a trifle heavier than the layer above but is fairly friable and easily penetrated by air, roots, and moisture. The subsoil gradually becomes lighter in color and more silty with depth and, in its lower part, consists of friable light grayish-brown or yellowish-brown silt. At a depth of 30 to 36 inches it merges with slightly altered Peorian loess, a light grayish-brown or brownish-white floury silt. Except locally, the soil material within a depth of 10 feet does not contain enough lime to produce noticeable effervescence when dilute hydrochloric acid is applied, but the crops and native vegetation do not indicate a deficiency in available calcium.

This type has all the essential plant nutrients and is well suited to any crop commonly grown in the area. Practically all of it is used for corn, oats, wheat, alfalfa, and clover that rank in acreage during most years in about the order named (pl. 2, *C*). The average yields, although somewhat lower than those on the level phase, are among the highest obtained on the uplands. They vary, chiefly, in accordance with the quantity and distribution of rainfall, being slightly higher on the smoother than on the more sloping areas. In seasons of above normal precipitation corn yields 60 to 70 bushels an acre, but over a period of years the average acre yield is much lower. Ordinarily wheat and oats yield about 18 and 35 bushels an acre respectively.

Cropping and land-management practices are similar to those followed elsewhere in eastern Nebraska. The soil is strong and productive and can stand severe cropping under rather poor management without serious reduction in yields. It is easily managed and, except locally, has not been damaged appreciably by erosion; but if maximum yields are to be obtained over long periods, more care is required in controlling water runoff and conserving soil moisture than is required on the more nearly level parts of the uplands and terraces. If properly managed, this soil will remain one of the best on the uplands for all crops common to the area. Corn yields especially may be increased under moisture-conservation practices (pl. 3, *A*).

The principal variation in this soil, aside from slight differences in surface features and in the thickness of the dark surface layer, is in the south-central part, where the soil is in close association with Butler and Crete soils. Here the upper part of the subsoil, although similar in color to that of the typical soil, has a little more clay and is slightly heavier and more compact than common. The increased compaction, however, is almost negligible as compared with that in the associated soils and has no noticeable effect on land values. Locally, where the Loveland loess or glacial drift is within 2 feet or less of the surface, the soil is a little more sandy than common and may be slightly reddish brown if enough Loveland is present. In these spots corn shows symptoms of phosphorus deficiency.

Sharpsburg silty clay loam, level phase.—This phase occurs on well-drained loessal uplands, where most slopes do not exceed 2 percent, and differs from the typical soil mainly in having more nearly even surface features. As mapped it occupies 256 acres, but numerous areas too small to show separately are included with the typical soil on the map. Although the soil has good drainage, runoff is not rapid enough to cause appreciable erosion.

More deeply developed than the typical soil, the surface and subsoil layers are somewhat thicker than normal. The 18-inch surface soil is friable and finely granular very dark grayish-brown or almost black silty clay loam. The subsoil is identical in color, structure, and consistence to that of other Sharpsburg soils and merges with the parent loess at a depth of 40 to 48 inches. No part of the soil indicates a calcium deficiency so far as crops are concerned.

Containing an abundance of organic matter and essential plant nutrients, this type is easily penetrated by air, roots, and moisture; has a high water-holding capacity; and, with less rapid runoff, absorbs water a little more readily than the more sloping soil. It is the most highly prized soil of the uplands, and practically all of it is cultivated. As it suffers less from loss of water through runoff, it is considered slightly better than the typical soil and considerably better than the rolling phase for grain crops. It seems, however, to have little or no advantage over either of these soils for growing alfalfa and sweetclover.

Sharpsburg silty clay loam, rolling phase.—The rolling phase occupies 43,200 acres on the well-drained loessal uplands where the land surface slopes in many directions and the gradient is between 5 and 10 percent. It differs from the typical soil mainly in having less even relief. On the tops of the lower and more rounded ridges the slopes vary slightly in gradient, but few of them are more than 10 percent. This soil has rather rapid surface drainage and, in places, has been damaged somewhat by accelerated erosion. Gullies are rather numerous but most of them can be crossed with all types of farm machinery.

In most places the dark surface layer is about 4 inches thinner than that of the typical soil, but it remains friable and finely granular and is amply thick except on the steeper slopes and in the vicinities of gullies where much of it has been removed. Severe surface soil thinning, however, occurs in a few small scattered areas. The subsoil is almost identical in color, structure, consistence, and depth to that of the typical soil. About 30 inches below the surface it merges with the parent loess.

Nearly all of this soil is used for the same crops as produced on the other Sharpsburg soils. Except in the most severely eroded areas, it seems to contain enough plant nutrients for high crop yields during seasons of ample precipitation. It suffers considerable loss of moisture through runoff and, in most years, crop yields average 20 to 30 percent below those obtained on the typical soil. In many small areas, where glacial drift underlies the soil at a depth of 3 or 4 feet, the subsoil moisture supply is somewhat increased during certain periods because the relatively impervious drift retards downward water percolation. These areas are too small to have a beneficial effect on crop yields except locally.

This soil can be cultivated under a fairly wide range of moisture conditions but requires more care in controlling erosion and conserving soil moisture, if maximum yields are to be obtained, than is required on any of the other Sharpsburg soils. The present cropping and land-management practices are similar to those on the normal type. Where soil- and moisture-conserving practices are properly followed, including contour farming and strip cropping with legumes, the soil is almost as productive as the typical soil.

Sogn silt loam.—This soil type occupies 64 acres and is developed from weathered limestone chiefly in the vicinity of Roca. Small areas are near limestone outcrops in the southern part but are too small to separate on the soil map and are included with the more extensive soils of the areas in which they occur. Most of the land has a slope of 10 to 20 percent. Runoff and erosion are excessive everywhere.

The surface layer varies from dark grayish brown to light yellow depending upon its organic-matter content. Ordinarily it is dark grayish-brown friable silt loam about 6 inches deep containing numerous fragments of partly weathered limestone and considerable organic matter. In many places this layer rests directly on the limestone bedrock. The subsoil, if present, is yellowish-brown silty clay loam rarely more than 8 inches thick. The depth of the soil depends partly on the resistance of the limestone to weathering but mainly on the extent and severity of erosion during and subsequent to its development. The soil material is limy from the surface downward.

Because of its stony character and unfavorable relief this type is not well suited to cultivation. It has all the essential plant nutrients but is difficult to manage, and, where cultivated, suffers severe losses of organic material and moisture through rapid runoff on the steep slopes. It is used almost entirely as pasture land. Grasses grow luxuriantly during seasons of normal or high precipitation and provide excellent pasture, but they commonly suffer from drought in the latter part of the summer. Trees do well during most years.

The chief need of this soil is a permanent vegetative cover. Care should be taken not to overgraze the pastures, because destruction of the grasses permits serious water erosion.

Steinauer loam.—This type occupies 12,992 acres in small and widely scattered areas where limy glacial drift underlies a thin soil. Most of it is on narrow ridges and on slopes of 5 to 10 percent or more. Runoff is rapid everywhere and water erosion is severe. On the steeper slopes are numerous gullies that cannot be crossed with farm machinery.

This soil is the thinnest and most immaturely developed of any on the glacial uplands. The surface layer varies considerably in color, texture, and depth but, in most places, it consists of dark-brown loam about 6 inches thick. The subsoil, where best developed, is merely a transitional layer of light-brown or yellowish-brown clay loam about 4 inches thick between the surface soil and the parent drift. In most places it is undeveloped and the surface soil rests directly on the slightly altered drift, which consists of a mixture of brown, grayish-brown, or slightly reddish-brown sand, silt, and clay. In many places the drift is exposed. Both the subsoil and the parent formation vary somewhat in texture and consistence, but they have enough silt and clay to be coherent and enough sand and gravel to be gritty. Ordinarily the soil contains numerous stones and boulders throughout, and it is highly calcareous from the surface downward.

In areas where the land is too steep, too stony, or too shallow and severely eroded to be well suited to cultivation, nearly all of this soil is in pasture or woodland. It is friable throughout and is easily penetrated by air, roots, and water but suffers excessive loss of moisture through runoff, and the yields of most crops on the few areas that are cultivated are about 25 percent lower than those obtained on Carrington loam. Alfalfa and sweetclover, however, do nearly as well as on that soil.

A vegetative cover of either close-growing crops or grasses should be kept on this type at all times to retard runoff and reduce water erosion. Under proper management, the soil will support considerable nutritious pasture grass and make desirable grazing land. Care should be taken not to overgraze the pastures, because after the grass cover is destroyed, the shallow surface soil soon erodes away. All trees suited to the climate do well.

The principal variation in this soil is where it adjoins areas of Burchard or Carrington soils. In these localities its surface layer is a little darker, finer textured, and thicker than common.

Steinauer-Burchard complex.—Soils belonging to this complex occupy 2,048 acres in areas where both the Steinauer and Burchard soils are about equally extensive and are so intricately associated in such small areas that their separate delineation on a map of the scale used is not justified.

In profile features, relief, drainage conditions, use suitability, and management requirements the Burchard soil of the complex is similar to Burchard clay loam, previously described, whereas the Steinauer soil corresponds to Steinauer loam. Most areas of this complex are strongly rolling to steeply sloping, excessively drained, and are used chiefly for pasture land, woodland, or both. Here and there small areas of the Burchard soil are cultivated. As a whole, the soils of the complex are subject to severe loss of soil material and moisture through erosion when cultivated and are better suited to grazing land. If managed properly, they provide good pasture and support numerous trees. The pastures should not be overgrazed.

Wabash fine sandy loam.—This soil type occupies 1,536 acres, chiefly along the smaller streams, and is the least extensive of any of the Wabash soils. It differs from Wabash silt loam only in having more fine sand in its surface layer, which consists of dark noncalcareous recent alluvium that has been washed mainly from the more sandy soils of the uplands. The surface features and the drainage and erosion conditions do not differ appreciably from those in areas of Wabash silt loam, and the two soils are used for the same crops with about equal success. The fine sandy loam has a slightly greater water-absorbing capacity than the silt loam and can be worked under a wider range of moisture conditions with slightly less power, but it is no more productive. Practically all of it, except that in the narrower stream valleys, is used for corn and alfalfa. The uncultivated areas produce a luxuriant growth of tall sod-forming grasses and considerable timber and are used mainly for pasture and woodland.

Wabash silt loam.—This type, the most extensive soil on the bottom lands, occupies 64,000 acres in more or less continuous strips of irregular widths on the flood plains along practically all the streams. The largest areas are along Salt Creek and its tributaries. In some places the surface is nearly level, except where modified by active or abandoned stream channels and slight elevations or shallow depressions. It is subject to overflow from the streams but all of it has sufficient slope to afford adequate surface drainage; none is subject to water erosion except along stream banks.

This soil is composed of dark lime-free alluvium that has not been greatly modified by soil-forming processes. In virgin areas the 10- to 15-inch surface soil consists of almost black finely granular friable silt loam. In most places the granulation has been destroyed in the upper 5- or 6-inch layer by tillage. The rest of the profile, to depths of 3 to 10 feet or more, consists of dark-colored silty or clayey alluvium, although layers of lighter colored or coarser textured material are not uncommon.

This soil contains an abundance of organic matter and moisture, is easily managed, and is as productive of corn, alfalfa, and sweetclover as any soil in Nebraska. Practically all of it is used for these crops. During most years corn yields 40 to 55 bushels an acre and alfalfa 2 to 4 tons (pl. 3, *B*). As with all soils on the bottom lands, small-grain crops make rank vegetal growth at the expense of the grain and mature rather late. No crop failures occur except in occasional years when the bottom land is flooded for unusually long periods. The only uncultivated areas are some narrow strips traversed by meandering stream channels. Most of these areas provide good pasture and contain numerous trees.

Wabash silty clay.—This type differs from the silt loam and fine sandy loam mainly in having a finer textured surface soil and less adequate surface drainage. It occupies 2,304 acres, mostly in shallow pockets and in sags and swales on the broad bottoms along the larger streams. Many areas are subject to rather frequent overflow, remain inundated longer than the surrounding land, and are too wet for cultivation.

The 12-inch surface layer consists of almost black heavy silty clay. The rest of the profile is made up of alternating layers of dark fine-textured soil material almost identical with that in Wabash silt loam, except that it has a slightly higher clay content and contains more rusty-brown, yellow, and gray spots, splotches, and streaks, indicating poor internal drainage. The soil is not noticeably limy but it contains enough available calcium for all crop needs. Although the lower subsoil layer has a rather high clay content it is not compact.

In common with most of the other Wabash soils, this type contains an abundance of organic matter and is well supplied with moisture. Where adequately drained, it is almost as productive of all crops common to the area as is Wabash silt loam, but it is much more difficult to manage. It remains wet later in spring and longer after rains than the latter soil and cannot be cultivated under as wide a range of moisture conditions. It is very difficult to plow when dry and if worked when wet it bakes and forms large lumps or clods that require subsequent wetting and drying or freezing and thawing before favorable tilth is restored. During periods of drought, the soil shrinks and cracks considerably, breaking many of the plant roots and promoting further parching, and losing considerable moisture through evaporation unless favorable tilth is maintained. The soil is better suited to corn and alfalfa than to small grains. Only a small percentage of it is cultivated. Grain yields depend mainly on drainage conditions and during most years they are considerably lower than those obtained on Wabash silt loam. Even in the cultivated areas, most of which are drained artificially, the crops commonly suffer from inundation.

The uncultivated areas, consisting chiefly of those that cannot be drained artificially without considerable expense, support a luxuriant grass growth and numerous trees and are used mainly for pasture and wild hay.

Wabash silty clay, saline phase.—Except for its higher salt content this phase and the typical soil are identical. It occupies 6,976 acres in flat poorly drained depressions on broad flood plains chiefly in the valleys along Salt and Rock Creeks and the lower courses of Little Salt, Oak, and Middle Creeks and Haines Branch. Most of the areas are subject to frequent overflow and prolonged inundation and cannot be drained artificially without considerable difficulty and expense.

This phase differs from Wabash silt loam chiefly in having a finer textured surface soil, poorer drainage, and enough salts to be injurious to cultivated crops and most grasses (pl. 3, *C*). The salts consist chiefly of chlorides and sulfates of sodium and calcium but also in places include some sodium carbonate. They are mainly in the upper 10- or 12-inch layer of the profile. The soil is not limy at any depth.

The chief use of this phase is for grazing. It supports fairly thick stands of saltgrass and western wheatgrass.

Waukesha silty clay loam.—This soil type occupies 17,984 acres on the nearly level parts of both high and low terraces but is best developed and most extensive on the older and higher terraces adjacent to the broad bottoms, as in Waverly, Oak, West Lincoln, Garfield, Yankee Hill, and Centerville Precincts. In these localities, and at a few other places, the high terraces are capped with silt similar to that of the loessal uplands and the soil on them does not differ materially from Sharpsburg silty clay loam. On the lower terraces located chiefly in narrow valleys, the soil is developed from silt washed from uplands and though similar to soils on the higher terraces in other respects its upper subsoil is slightly darker. All areas have medium to good surface and internal drainage, and none of them is subject to serious erosion.

The mellow finely granular silty clay loam surface soil is about 14 inches thick, contains an abundance of organic material, and is dark grayish brown when dry or almost black when wet. The brown or dark-brown coarsely granular silty clay loam subsoil, in its upper part, is slightly heavier than the layer above but friable throughout. On the high terraces, it gradually becomes lighter colored and more silty and friable downward, consisting of light-brown or yellowish-brown silt loam below a depth of about 30 inches. At about 4 feet below the surface the material becomes a light grayish-brown or brownish-white floury silt similar to that below the Sharpsburg soils. On the lower terraces the subsoil is rather dark-brown friable clay loam to depths exceeding 4 feet in most places and usually is underlain by alternating layers of dark-colored clayey, silty, or fine sandy alluvium. No part of the soil or underlying material in either place is noticeably calcareous.

This soil is well suited to any of the crops commonly grown and is considered the best general farming soil in the county. It is easily managed and on many farms has withstood severe cropping over long periods without serious reduction in yields. Practically all of it is cultivated. Corn is the principal crop and is followed by wheat, oats, and alfalfa, ranking in acreage during most years in the order named. Although most of it is used for corn, a larger part of it than of any other soil in the county, is used for wheat because it produces better returns in most years. All the crops yield more than on the best soils of the uplands because of the greater supply of moisture on the terraces. Alfalfa can be grown more frequently than on the uplands without depleting the deep-seated soil moisture.

Included with this soil are a few small areas of Waukesha fine sandy loam and Judson silt loam, too small and unimportant agriculturally to separate on the map. Waukesha fine sandy loam differs from the silty clay loam mainly in having a larger percentage of fine sand and very fine sand in its surface soil. Generally it occurs on lower terraces near the mouths of streams issuing from the glaciated uplands, and its coarser surface soil is produced by additions of sandy material washed from the glacial drift. Judson silt loam consists of a uniform mass of almost black silty surface soil that has accumulated to a depth of 3 feet or more on the terraces at the base of slopes leading to the uplands. It is more productive than any other soil in the county but because of its small extent is of minor importance.

Waukesha silty clay loam, undulating phase.—This phase differs from the typical soil only in having less even relief. It occupies 10,944 acres on many of the low narrow terraces, but most of it on the older and higher terraces, in areas where the land is undulating or gently sloping, ranges from 2 to 5 percent. The soil has good drainage but is not subject to washing except in a few places where runoff is sufficiently rapid to cause slight erosion.

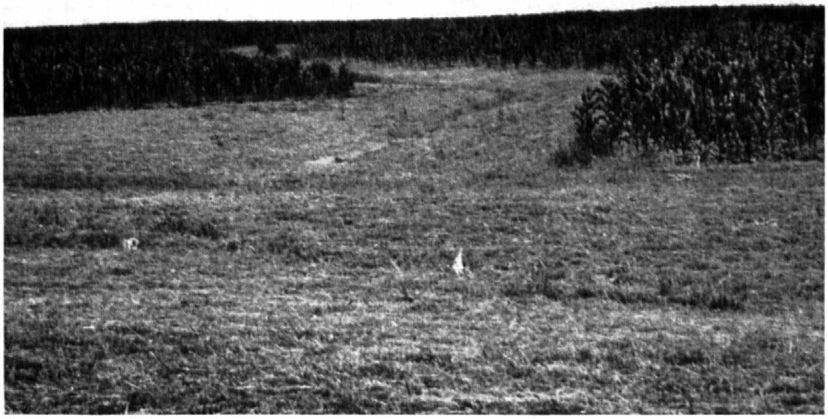
Practically all of this phase is cultivated. Like the typical soil, it is easily managed and is well suited to all crops common to the area, but it suffers a little greater loss of water through runoff than that soil and usually produces slightly lower yields of grain crops under the prevailing or similar farming practices. For optimum yields, a little more care is necessary in controlling runoff than on the more nearly level typical soil, but where properly managed it is about as productive of all crops as that soil.

PRODUCTIVITY RATINGS AND LAND CLASSIFICATION

The soils of Lancaster County are listed alphabetically in table 8 and estimated average acre yields of the principal crops are given for each one under the prevailing farming practices. On the arable lands these practices include a rather indefinite system of rotating corn, wheat, and oats, together with the occasional use of alfalfa and sweetclover. The greater part of the arable land is used for corn. Lime and commercial fertilizers are not generally used. The principal crops grown or type of farming practiced at present is given in the right-hand column of the table.

TABLE 8.—*Estimated average per acre yields of the principal crops on each soil in Lancester County, Nebr., under prevailing practices* [1]

Soil [2]	Corn	Wheat	Oats	Barley	Rye	Alfalfa	Sweet-clover	Wild hay	Pastures	Principal crops or type of farming
	Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [3]	
Bremer silt loam	43	16	33	26	16	3.4	1.7	0.90	110	Corn and alfalfa
Burchard clay loam [4]	15	7	13	10	7	1.0	.7	.35	55	Small grains, wild hay, and pasture.
Hill phase [5]								.35	50	Pasture and wild hay.
Butler silty clay loam	28	16	33	26	16	2.4	1.2	.70	90	General farming
Carrington loam [4]	23	9	18	14	9	1.8	.9	.50	70	Small grains, wild hay, and pasture
Rolling phase [4]	15	8	15	12	8	1.6	.8	.45	65	Do.
Steep phase [5]								.35	50	Pasture and wild hay.
Carrington silty clay loam	30	15	30	24	15	2.4	1.2	.65	85	General farming
Rolling phase	20	10	20	16	10	2.0	1.0	.55	75	Do
Steep phase [5]								.40	60	Pasture and wild hay
Crete silty clay loam	25	15	30	24	15	2.4	1.2	.65	85	General farming
Crete-Sharpsburg silty clay loams	18	10	20	16	10	2.0	1.0	.60	80	Do
Dickinson sandy loam [5]								.30	40	Pasture and wild hay.
Judson silt loam	43	19	38	30	19	3.4	1.7	.80	100	General farming
Judson-Wabash fine sandy loams	40	16	33	26	16	3.4	1.7	.80	100	Pasture and hay with some corn and alfalfa.
Judson-Wabash silt loams	43	18	35	28	18	3.4	1.7	.90	110	Do.
Lamoure silty clay										
Well drained	40	15	30	24	15	3.4	1.7	.95	115	Corn and alfalfa
Poorly drained								1.00	120	Pasture and wild hay.
Saline phase								.50	80	Pasture.
Lancaster sandy loam								.30	40	Pasture and woodland.
Pawnee silty clay loam	15	9	18	14	9	1.6	.8	.50	70	Small grains, wild hay, and pasture
Rokeby silty clay loam	28	16	33	26	16	2.8	1.4	.70	90	General farming.
Sharpsburg silty clay loam	35	18	35	28	18	2.4	1.2	.65	85	Do
Level phase	40	20	40	32	20	2.4	1.2	.70	90	Do
Rolling phase	28	13	25	20	13	2.0	1.0	.60	80	Do
Sogn silt loam									30	Pasture and woodland.
Steinauer loam [5]								.30	40	Pasture and wild hay
Steinauer-Burchard complex								.35	50	Do.
Wabash fine sandy loam										
Well drained	40	13	25	20	14	3.4	1.7	.80	100	Corn and alfalfa
Poorly drained								.90	110	Pasture and hay.
Wabash silt loam										
Well drained	43	15	30	24	15	3.4	1.7	.90	110	Corn and alfalfa.
Poorly drained [5]								1.00	120	Pasture and hay.



A, Corn planted on the contour and grass on the waterways help to hold rain water and check erosion Sharpsburg silty clay loam in middleground and background. Small area of Judson-Wabash soils in foreground. *B*, Wabash silt loam in center on Cheese Creek flood plain in SE¼ sec 20, T 9 N, R. 5 E Corn yields are high on this type Carrington soils are on uplands in background *C*, Wabash silty clay, saline phase, near W¼ sec 12, T 11 N, R. 6 E. Salty spot shown in foreground

1/ Under prevailing practices; absence of yield indicates crop not commonly grown on particular soil.

2/ Considerables areas either too steep, rough, or stony to be cultivated. Yields apply only to smoother and less stony areas.

3/ Used to express carrying capacity or grazing value of pasture, representing number of days that 1 animal unit can be supported on 1 acre during grazing season without injury to pasture; grazing season in County is about 6 months.

4/ No yields for grain and tame-grass hay crops given for soils generally unsuited to cultivation, though some areas may be cultivated.

Wabash silty clay.										
Well drained	40	15	30	24	15	3.4	1.7	.95	115	Corn and alfalfa.
Poorly drained								1.00	120	Pasture and hay.
Saline phase								.50	80	Pasture.
Waukesha silty clay loam	40	20	40	32	20	3.2	1.6	.75	90	General farming.
Undulating phase	35	18	35	28	18	3.2	1.6	.70	90	Do.

[1] Prepared jointly by the Bureau of Plant Industry, Soils, and Agricultural Engineering and the Bureau of Agricultural Economics, U. S. Department of Agriculture; and the Conservation and Survey Division, University of Nebraska. Absence of a yield estimate indicates that the crop is not commonly grown on the particular soil.

[2] Listed alphabetically according to the series.

[3] Used to express the carrying capacity or grazing value of pasture, this term represents the number of days that 1 animal unit can be supported on 1 acre during the grazing season without injury to the pasture, the grazing season in Lancaster County is about 6 months.

[4] Considerable areas of these soils are either too steep, rough, or stony to be cultivated. Yields apply only to the smoother and less stony areas.

[5] No yields for grain and tame-hay crops are given for soils generally unsuited to cultivation, though some areas may be cultivated.

The estimates in table 8 are based primarily on interviews with farmers, the county agricultural agent, and members of the staffs of the Nebraska Agricultural Experiment Station and College of Agriculture and were prepared jointly by the Bureau of Plant Industry, Soils, and Agricultural Engineering and the Bureau of Agricultural Economics, United States Department of Agriculture; and the Conservation and Survey Division, University of Nebraska.[10] They are presented as estimates of the average production over a period of years according to the prevailing type of farming. They may not apply directly to specific tracts of land for any particular year, inasmuch as the same soils as shown on the map vary somewhat from place to place, practices of management differ slightly, and climatic conditions fluctuate from year to year. On the other hand, these estimates appear to be as accurate as can be obtained without further detailed and lengthy investigations, and they serve to bring out the relative productivity of the soils shown on the map.

Two estimates of yields are given for the soils on the bottom lands or flood plains—one applies to the well-drained areas and the other to those poorly drained. The soil map, however, does not distinguish between these areas except in localities where drainage is so poor that a marshy condition prevails a part of each year. In such places 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 cannot be shown on the map. Streams occasionally inundate the flood plains, but no special consideration is given to overflow because it is of little importance in the agriculture of the county.

In order to compare directly the yields obtained in Lancaster County with those in other parts of the country, yield figures have been converted in table 9 to indexes based on standard yields. The soils are grouped in the approximate order of their general productivity under prevailing practices, the most productive first.

[10] Data on long-time yields for specific soils were collected by the field personnel during and subsequent to the survey. Free use also was made of unpublished estimates on average annual crop yields for the 10-year period 1923–32, supplied by the Bureau of Agricultural Economics, U. S. Department of Agriculture, cooperating with the Nebraska Department of Agriculture.

TABLE 9.—*Productivity ratings of soils in Lancaster County, Nebr.*

Soil [2]	Crop productivity index [3] for—									General productivity		Physical suitability for use
	Corn (100=50 bu.)	Wheat (100=25 bu.)	Oats (100=50 bu.)	Barley (100=40 bu.)	Rye (100=25 bu.)	Alfalfa (100=4 tons)	Sweetclover (100=2 tons)	Wild hay (100=1 ton)	Pasture (100=100 cow-acre-days) [4]	Grade [5]	Group [6]	
Judson silt loam	86	76	76	75	76	85	85	80	100	2	High	Good cropland (Topography is generally favorable for tillage operations without any great hazard of serious erosion. High inherent fertility. Moisture relations generally satisfactory except in periods of extreme drought. Suited to the common crops, particularly corn and alfalfa. The soils of the first bottoms less well suited to the small grains than to corn and hay crops.)
Judson-Wabash silt loams	86	72	70	70	72	85	85	90	110	2		
Waukesha silty clay loam	80	80	80	80	80	80	80	75	90	2		
Bremer silt loam	86	64	66	65	64	85	85	90	110	2		
Wabash silt loam (well drained)	86	60	60	60	60	85	85	90	110	3		
Sharpsburg silty clay loam, level phase	76	76	76	76	76	60	60	70	90	3		
Judson-Wabash fine sandy loams	80	64	66	65	64	85	85	80	100	3		
Wabash silty clay (well drained)	80	60	60	60	60	85	85	95	115	3		
Lamoure silty clay (well drained)	80	60	60	60	60	85	85	95	115	3		
Wabash fine sandy loam (well drained)	80	52	50	50	56	85	85	80	100	3		
Waukesha silty clay loam, undulating phase	70	72	70	70	72	80	80	70	90	3		
Sharpsburg silty clay loam	70	72	70	70	72	60	60	65	85	3	Moderate	Fair cropland. (Certain unfavorable characteristics, as claypan, rolling topography, or lower moisture-holding capacity, lower the suitability of these soils for the common crops.)
Rokeby silty clay loam	56	64	66	65	64	70	70	70	90	4		
Butler silty clay loam	56	64	66	65	64	60	60	70	90	4		
Carrington silty clay loam	60	60	60	60	60	60	60	65	75	4		
Crete silty clay loam	50	60	60	60	60	60	60	65	85	5		
Sharpsburg silty clay loam, rolling phase	56	52	50	50	52	50	50	60	80	5		
Carrington silty clay loam, rolling phase	40	40	40	40	40	50	50	55	75	6	Moderate to low.	Fair to poor cropland. (Poor drainage, rolling topography, claypan, or lower inherent fertility are the principal characteristics that make these soils generally not well suited to cropland. Some are particularly productive of wild hay and pasture.)
Carrington loam [7]	46	36	36	35	36	45	45	50	70	6		
Crete-Sharpsburg silty clay loams	36	40	40	40	40	50	50	60	80	6		
Pawnee silty clay loam	30	36	36	35	36	40	40	50	70	7		
Carrington loam, rolling phase [7]	30	32	30	30	32	40	40	45	65	7		
Burchard clay loam [7]	30	28	26	25	28	25	35	35	75	7		
Wabash silt loam (poorly drained) [8]								100	120	7		
Wabash silty clay (poorly drained)								100	120	7		
Lamoure silty clay (poorly drained)								100	120	7		
Wabash fine sandy loam (poorly drained)								90	110	7		

See footnotes at end of table.

TABLE 9.—*Productivity ratings of soils in Lancaster County, Nebr.*[1]—Continued

Soil[2]	Crop productivity index[3] for—									General productivity		Physical suitability for use
	Corn (100=50 bu.)	Wheat (100=25 bu.)	Oats (100=50 bu.)	Barley (100=40 bu.)	Rye (100=25 bu.)	Alfalfa (100=4 tons)	Sweetclover (100=2 tons)	Wild hay (100=1 ton)	Pasture (100=100 cow-acre-days)	Grade[5]	Group[6]	
Wabash silty clay, saline phase								50	80	8	Low	Fair to good pasture land. (Poor drainage, steep slopes, or poor moisture relations are the principal characteristics that make these soils generally unsuited to cropland, although a few areas are cultivated. Their best use is for pasture. Some areas are wooded.)
Lamoure silty clay, saline phase								50	80	8		
Carrington silty clay loam, steep phase[8]								40	60	9		
Carrington loam, steep phase								35	50	9		
Burchard clay loam, hill phase[8]								35	50	9		
Steinauer-Burchard complex								35	50	9		
Steinauer loam[8]								30	40	9		
Dickinson sandy loam[8]								30	40	9		
Lancaster sandy loam								30	40	9		
Sogn silt loam									30	10	Very low	Poor pasture land. (Less productive of pasture than the soils of the above group. Trees are common.)

[1] Prepared jointly by the Bureau of Plant Industry, Soils, and Agricultural Engineering and the Bureau of Agricultural Economics, U. S. Department of Agriculture; and the Conservation and Survey Division, University of Nebraska.

[2] Listed in approximate order of productivity, the most productive first.

[3] The indexes given indicate the approximate average production of each crop as a percentage of the standard of reference. The standard represents the approximate average yield obtained without fertilizers or amendments on the more extensive and better soil types of the regions of the United States in which the crop is most widely grown. The indexes are based on estimates of yield (see table 8), as specific yield data are limited. Absence of indexes indicate that the crop is not commonly grown on the particular soil.

[4] See footnote 3, table 8

[5] Numbers indicate the general productivity of the soils for the common crops.

[6] A generalized statement of relative productivity.

[7] See footnote 4, table 8.

[8] See footnote 5, table 8.

The rating compares the productivity of each of the soil types for each given crop to a standard of 100. This standard index represents the approximate average acre yield obtained without the use of amendments on the more extensive and better soil types of the regions of the United States in which the crop is most widely grown. An index of 50 indicates that the soil is about half as productive for the specified crop as is the soil with the standard index. The standard yield for each crop shown in table 9 is given at the head of each respective column. Soils given amendments, as lime and commercial fertilizers, or special practices, as irrigation, and unusually productive soils of small extent may have productivity indexes of more than 100 for some crops. The indexes for wild hay and pasture are probably less satisfactory than those for the specified crop.

General productivity grade numbers are assigned in the column "General productivity grade." This grade is based on a weighted average of the indexes for the various crops, the weighting depending on the relative acreage and value of the crops. If the weighted average is between 90 and 100, the soil type is given a grade of 1; if it is between 80 and 90, a grade of 2 is given; and so on. Determination of the general productivity grade numbers and the order of placement of the soils is based on personal judgment combined with the following percentage weightings of the crop indexes.

For soils generally used for cultivated crops:

Crop:	*Percent*
Corn	50
Wheat	20
Oats	10
Alfalfa	15
Pasture	5

For soils generally used for pasture:

Pasture	30

As it is difficult to measure mathematically either the exact significance of a crop in the agriculture of an area or the importance or suitability of certain soils for particular crops, perhaps too much significance may be given to the order in which the soils are listed. The arrangement, however, does give information as to general productivity. Descriptive terms of general productivity for groups of soils are given in the column "General productivity group."

The rather low productivity indexes given to some of the soils in table 9 do not indicate necessarily that these soils are poorly suited for the crops grown on them. Many of the soils are among the strongest and most productive in the general region. Few of them give as high yields of a particular crop as are obtained on what is regarded as a standard soil of reference for that crop, but this, in most instances, is mainly because of less favorable moisture conditions or surface features, or both, than occur in areas of the standard soils. Nearly all of the soils contain enough plant nutrients to insure higher yields if precipitation were more abundant.

The right-hand column of table 9 gives a few statements as to the general characteristics and physical suitability for use of the soils of each general productivity group. A grouping of soils on the basis of general productivity will not necessarily coincide in all respects with a grouping on a basis of physical suitability for use, since other characteristics in addition to productivity influence the general desirability of soils in respect to their use for crops. For example, slight differences in productivity may be overshadowed by differences in workability or the maintenance of productivity and the prevention of erosion. The statements given here for each productivity group are applicable to the group as a whole, but it is to be remembered that the arrangement or order of listing soils is based on general productivity.

The principal factors affecting the productivity of land are climate, soil (this includes the many physical, chemical, and biological characteristics), slope, drainage, and management, including the use of amendments. No one of these factors operates separately from the others, although some one may dominate. The factors listed may be grouped simply as the soil factor and the management factor. Slope, drainage, and most of the aspects of climate may be considered characteristics of a given soil type since the soil type, as such, occupies specific geographic areas characterized by a given range of slope and climatic conditions. Crop yields over a long period of years furnish the best available summation of the associated factors and, therefore, are used where available.

Productivity tables do not present the relative roles that soil types, because of their extent and the pattern of their distribution, play in the agriculture of the country. The tables show the relative productivity of individual soils. They cannot picture in a given county the total quantitative production of crops by soil areas without the additional knowledge of the acreage of the individual soil types used for each of the specified crops.

Economic considerations play no part in determining the crop productivity indexes. They cannot be interpreted, therefore, into land values except in a very general way. Distance to market, relative prices of farm products, and other factors influence the value of land. It is important to realize that productivity, as measured by yields, is not the only consideration that determines the relative worth of a soil for growing crops. The ease or difficulty of tillage and the ease or difficulty with which productivity is maintained are examples of considerations other than productivity that influence the general desirability of a soil for agricultural use. In turn, steepness of slope, presence or absence of stone, resistance to tillage offered by the soil because of its consistence or structure, and size and shape of areas are characteristics of soils that affect the relative ease with which they can be tilled. Likewise, inherent fertility and susceptibility to erosion are characteristics that influence the ease of maintaining soil productivity at a given level. Productivity, as measured by yields, is influenced to some degree by all these and other factors, as moisture-holding capacity of the soil and its permeability to roots and water, and so they are not factors to be considered entirely separately from productivity. On the other hand, schemes of land classification to designate the relative suitability of land for agricultural use must give some recognition to such factors.

LAND USE AND MANAGEMENT

The management of the land in this county is about the same as that generally followed throughout southeastern Nebraska and the adjacent parts of the adjoining States.

General farming practices, including tillage methods and the kinds of crops grown, have not changed markedly in the past 20 years although the proportional acreage used for the different crops has varied from year to year in accordance with differences in the market conditions, and the average acre yields of some of the crops have been considerably increased by crop breeding. Most of the land is used to grow feed for livestock, which is the chief source of revenue. So long as an adequate supply of feed is produced, soil-building and soil-conserving crops can be grown as extensively as desired without detracting from the net annual farm income and much of the fertility removed from the soils by the feed crops can be returned through animal manure.

Nearly all the soils are fertile enough to produce optimum yields of the crops to which they are suited without the addition of commercial fertilizer, provided the crop refuse is returned to the land and an adequate moisture supply is available. Some of the soils, including those of the Steinauer, Burchard, Sogn, and Lancaster series, and the steep phases of the Carrington soils, are on slopes too steep to justify the expense of maintaining either the fertility or the moisture supply at levels suitable for continued production of cultivated crops. These soils, however, occupying only a small percentage of the total area, are well suited to native grasses and trees and all of them are needed to supply pasture for the work animals and milk cows on the farms.

Aside from a few wet spots only the areas occupied by Wabash and Lamoure silty clays and their saline phases and a few depressed areas of Butler silty clay loam are too poorly drained for cultivation, and these areas constitute less than 5 percent of the total land area. They support a luxuriant growth of native grasses and nearly all are used profitably for hay or pasture.

With few exceptions the remaining soils, which occupy more than three-fourths of the total area, are well suited to cultivated crops. As previously indicated, the limiting factor in determining the producing capacity of these soils is the moisture supply rather than the quantity or availability of plant nutrients. Local areas in which the dark surface soil has become very thin remain fairly productive of all the common crops provided water runoff is controlled through moisture-conservation practices. Throughout most of the arable uplands, even the steeper slopes and the shoulders of hills, where the dark surface soil has been removed, are highly productive if legumes are grown often enough to maintain a favorable quantity of nitrogen and the moisture supply is adequate. Especially is this true in those parts occupied by the Sharpsburg soils, which have developed from loess and are by far the most extensive. The loess itself holds enough available plant nutrients, except nitrogen, to produce much higher yields of all the common crops than its moisture supply will permit. An adequate supply of nitrogen is easily maintained by rotating the grain crops with legumes; therefore facilities to conserve the precipitation for plant use becomes the chief requirement for increased crop production.

It is not unreasonable to assume that at least 30 percent of the precipitation that falls on the arable soils of the uplands and terraces runs off the land and that probably another 30 or possibly 40 percent evaporates before it can be of significant benefit to the crops under prevailing

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farm practices. On a few farms a part of the water wastage resulting from runoff is prevented by cultivating the land on contours especially in fields so shaped as to facilitate this type of cultivation; but as a whole, contour farming is not practiced in the county chiefly because it results in an excessive number of short rows in the rectangular fields and is thought to be more time-consuming than the conventional straight rows.

Strip cropping, by which alternate strips of close-growing and row crops extend at right angles to the slopes, is practiced on a few farms with beneficial results, but like other types of contour farming, this is not so generally followed as would be desirable.

The practice of maintaining enough undecomposed or partly decomposed vegetal material on and in the surface layer of the soil to facilitate rapid water absorption in cultivated fields seems to be generally favored for moisture conservation and is followed by many farmers. This practice is highly efficient when used alone but probably would be more effective when used in connection with some form of contour farming.

Although the available moisture supply is the leading factor in determining the yield and profit from the crops on all the arable soils, the nitrogen supply ranks next in importance. In seasons of abundant precipitation, the corn yield especially is greater when the crop follows a legume in the rotation. In dry years the relatively large nitrogen supply left in the soil by a preceding crop of alfalfa or sweetclover may cause the corn plants to produce a rank early vegetal growth that the subsoil moisture cannot support during late summer because the legume crop of the previous season has drawn heavily on the moisture supply; thus, the crop suffers seriously at the time it should be maturing. For this reason, it is generally advisable to follow legumes with small grains before growing corn, although the small grains, in turn, are subject to drought in some degree in dry years and lodging in the wetter years. Listed corn is considered by most farmers to be more drought resistant than that planted in checkrows. The checkrow method, however, allows cultivation of the crop in two directions, thus facilitating better weed control and is generally used on the bottom lands, terraces, and more nearly level parts of the uplands. The main value of cultivation, according to tests, is to eradicate weeds and any stirring of the ground in excess of this requirement, provided the soil is in favorable tilth, is not likely to prove profitable. Corn on the Wabash, Lamoure, and Bremer soils commonly requires more cultivation than that on the uplands and terraces, because of the more rapid growth of weeds on the bottom lands.

MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of the forces of weathering and soil development acting on the parent soil material deposited or accumulated by geologic agencies. The characteristics of the soil at any given point depend on (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and has existed since accumulation; (3) the plant and animal life in and on the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of development have acted on the material The climate, and its influence on soil and plants, depends not only on temperature, rainfall, and humidity but also on the physical characteristics of the soil or soil material and on the relief, which, in turn, strongly influences drainage, aeration, runoff, erosion, and exposure to sun and wind.

Lancaster County is in the western part of the Central Lowland province of the United States. The soils have developed under grasses in a region of midcontinental climate characterized by high summer and moderate to low winter temperatures. The mean annual precipitation of 27.94 inches, as recorded at Lincoln, supports a luxuriant growth of typical prairie grasses. The same species grow more luxuriantly on the bottom lands and other moist situations.

Forest occurs in narrow strips along some of the streams, but the tree cover is not sufficiently dense to prevent the growth of grass or to influence notably the character of the soils. Organic matter, derived principally from decayed grass roots, has produced very dark, in places almost black, surface layers except in local areas where the soils are developing on the most recently exposed geologic materials.

Rainfall has been sufficient, except in areas where runoff is rapid or a claypan restricts downward water movement, to remove the readily soluble salts from the entire solum and, in most places, from the upper part of the underlying formation; but nowhere has acidity developed so that it inhibits the growth of any farm crop common to the area. Most of the surface soils are neutral, and the rest of the solum is slightly alkaline. In a few steeply sloping and severely eroded places where the parent materials are at or near the surface, the soils are moderately calcareous. A limy layer also occurs in the lower part of the subsoil of all soils in which a claypan has developed, but the parent material beneath this layer is not appreciably calcareous in most places.

The granular structure of the surface layer so characteristic of most soils in the Central Lowland is typically developed in all except the more sandy, the more severely eroded, and the least developed soils.

Surface and internal drainage are good on all the soils except a few on those parts of the flood plains that have a high water table or are subject to frequent inundations and a few on the uplands where a claypan has developed, causing poor internal drainage.

The more extensive soils are the Sharpsburg, which have developed on the uplands, chiefly in undulating to gently rolling areas, from Peorian loess, a light grayish-yellow floury wind-laid silt. In cultivated fields these soils are somewhat eroded, but in most of the pastures they still retain practically all the products of soil development. They are regarded as normal soils for the Central Lowland area.

Following is a description of a profile of Sharpsburg silty clay loam observed north of the southwest corner of sec. 13, T. 12 N., R. 6 E.; in this locality, which is a virgin-hay meadow, the soil is on a well-drained divide having a 3-percent slope.

A_1. 0 to 6 inches, very dark grayish-brown or almost black friable finely granular silty clay loam. The granules are small and poorly defined in the upper half of the layer but are made up largely of distinct, though soft and easily broken, subspherical aggregates about one-sixteenth of an inch in diameter in the lower part The layer contains an abundance of organic matter intimately mixed with the mineral constituents. No color change occurs when a lump is crushed

A_2. 6 to 14 inches, dark grayish-brown granular silty clay loam. The granules are slightly larger and a little firmer than in the layer above. Those in the lower part of the layer are thinly coated with well-decomposed organic matter, and when crushed, the material becomes slightly lighter in color than it is in the granular form.

B_{21}. 14 to 24 inches, dark grayish-brown or dark-brown moderately heavy though coarsely granular fairly friable silty clay. The granules average one-eighth of an inch in diameter, are firm, are coated with organic material, and without difficulty can be crushed to a brown or light-brown powder. This upper part of the subsoil is the heaviest horizon in the profile, but its increased heaviness is scarcely noticeable except through close comparison with the horizon above and the one below.

B_{22}. 24 to 36 inches, brown or light-brown coarsely granular to cloddy friable silty clay loam. The granules in the upper part of this horizon are similar to those in the overlaying layer but give way to an ill-defined cloddy structure below. The material crushes easily to form a light-gray powder.

C_1. 36 to 48 inches, light-brown or grayish-brown friable slightly altered silt or silty clay loam of the parent loess. This layer contains numerous brown and rust-brown spots, splotches, and streaks.

C_2. 48 to 96 inches, yellowish-brown or grayish-yellow floury silty clay loam of the Peorian loess. Scattered lime concretions are in the lower part of this layer in places. The loess does not react noticeably with dilute hydrochloric acid except at the concretions.

The organic matter practically disappears at a depth of about 30 inches. Insect casts are numerous in the A_2 and B_{21} layers of the B_{22} layer contains many crooked rodlike forms about one-fourth inch in diameter and of various lengths, which are lighter or darker than the surrounding matrix. They represent soil fillings in old root, worm, and insect holes and are known as krotovinas. They also occur in the lower subsoil layers in nearly all areas of this soil.

The profile described is similar to that of all the nearly mature soils in the county. It is almost identical with the profile of Waukesha silty clay loam, which occurs on the well-drained terraces. It differs from the profile of the best developed Carrington soil that is formed on glacial drift, the next lower geologic formation, mainly in being finer textured and more friable.

The following description of a profile of Carrington silty clay loam observed east of the northwest corner of sec. 21, T. 12 N., R. 6 E., on a gently sloping divide is typical of normal soil development on glacial drift in this area.

A_1. 0 to 6 inches, very dark grayish-brown granular friable silty clay loam containing numerous small pebbles, a small quantity of sand, and an abundance of organic material, the last intimately mixed with the mineral constituents. The granules are fairly well formed, average about one-sixteenth of an inch in diameter, and are little or no darker in their natural form than when crushed.

A_2. 6 to 14 inches, dark grayish-brown coarsely granular silty clay, moderately rich in organic matter, and containing occasional small stones and pebbles. The granules are larger and firmer than in the horizon above and are coated with organic material. When crushed, they form a powder that is only slightly lighter colored than the granular mass.

B_{21}. 14 to 24 inches, dark-brown coarsely granular and heavy but moderately friable silty clay loam containing numerous small stones and pebbles, some sand, and considerable clay. It has a distinctly gritty feel, and is easily penetrated by air, roots, and water, although it is much heavier than the horizon above. The granules average one-eighth in diameter and are quite firm. They have practically the same color throughout.

$B_{2\,2}$. 24 to 40 inches, brown or light-brown heavy and moderately compact silty clay containing numerous stones and pebbles. The upper part is similar to the horizon above but the granules gradually become larger and less distinct with increased depth and give way to a massive or ill-defined cloddy structure in the lower part.

C_1. 40 to 60 inches, light-brown or yellowish-brown heavy clay loam containing numerous stones, scattered boulders, and enough sand to be gritty. This material is only slightly altered parent drift.

The mechanical analyses of Carrington and Sharpsburg silty clay loams are given in table 10.

TABLE 10.—*Mechanical analyses of 2 soils in Lancaster County, Nebr.*

Soil type and sample No.	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
Carrington silty clay loam:	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
379277	0–6	0 3	0 7	1.0	2 6	4.0	58.1	33.3
379278	6–14	2	1.2	1.6	2.7	3 8	48 9	41 6
379279	14–24	8	1 9	2 5	4.0	5.0	49.3	35 9
379280	24–40	1 0	2 5	3.1	5.3	6.1	41 9	40 1
379281	40–48	2 5	3.5	3.4	6.0	6 1	36.6	41.9
379282	48–60+	3 6	3.0	3.6	7.3	7.0	32.3	42 0
Sharpsburg silty clay loam:								
379252	0–6	.2	.3	3	1 2	4.7	59 9	33 4
379253	6–14	.1	1	2	.6	3 1	52.7	43 2
379254	14–24	.0	1	1	.3	2.2	56 7	40 6
379255	24–36	0	.0	2	4	2.7	60 2	36 5
379256	36–48	.0	.1	.1	.3	2.6	64 5	32 4
379257	48–60	1	.3	.2	6	3.0	66.0	29.8
379258	60–72	.1	.1	.1	.4	2.4	68.9	28.0
379259	72–96+	.1	.2	.1	.3	3 0	68.5	27 8

Over much of the southern part of the county a generally smooth surface has facilitated increased downward moisture percolation in the loess deposit. In these areas much clay has been carried down from the surface soil and has accumulated in the upper part of the subsoil, where it has formed an extremely dense clay layer. The resultant soil, a Planosol, is Butler silty clay loam. It differs from Sharpsburg silty clay loam mainly in having a claypan and a zone of lime enrichment that has been protected from leaching by the claypan layer.

Following is a description of Butler silty clay loam observed in the northwest corner of sec. 16, T. 7 N., R. 8 E., on a broad nearly level loess-capped divide.

A_1. 0 to 6 inches, very dark grayish-brown or almost black finely granular friable silty clay loam. The granules are soft, poorly developed, and most of them have been destroyed by tillage. The material contains an abundance of organic matter intimately mixed with the mineral constituents and does not change color when crushed.

A_2. 6 to 14 inches, very dark grayish-brown granular silty clay loam. This horizon differs from the one above mainly in the size and consistence of the granules, which average one-sixteenth of an inch in diameter and are firm but crush readily in the hand to form a powder nearly as dark as the uncrushed material. The layer is a trifle heavier than the one above, but it is friable and easily penetrated by air, roots, and moisture.

A_3. 14 to 18 inches, grayish-brown friable silty clay loam of ill-defined granular structure, the granules covered with a thin film of leached silt that gives them a rather light-colored surface appearance.

B_1. 18 to 30 inches, dark grayish-brown or nearly black heavy compact clay. This horizon, which is a true claypan, is generally massive and almost impervious to air, roots, and water. Material from it can be crushed with much difficulty. It contacts with the layer above abruptly.

B_3. 30 to 48 inches, dark-brown or brown massive to cloddy moderately heavy clay loam, containing numerous rust-brown streaks, splotches, and stains and considerable concretionary lime.

C_1. 48 to 60 inches, light grayish-brown or yellowish-brown friable massive silty clay loam of the slightly altered parent loess. This material contains a few small widely scattered lime concretions and an occasional brown or rust-brown spot. It does not react when dilute hydrochloric acid is applied except in the immediate vicinity of the concretions.

The Rokeby soils have profiles almost identical with the Butler but are on terraces instead of uplands. The Pawnee soils also resemble the Butler in general profile features but are on heavy glacial drift instead of floury loess and occupy more rolling land. The Pawnee soils are not classed as true Planosols, because the heavy subsoil layer is presumably derived from the heavy parent material and is not a result of eluviation and consequent illuviation. The Crete soils are Planosols associated with Butler and Sharpsburg soils. They occupy more sloping land and have browner and less compact subsoils than the Butler soils.

The remaining soils of the county consist chiefly of Lithosols, developed either on sandstone, limestone, or glacial drift throughout the uplands; and of alluvial soils, developed in relatively recent stream deposits on the flood plains. All are immature and vary in character chiefly in accordance with differences in the bedrock or the alluvium on which they are forming.

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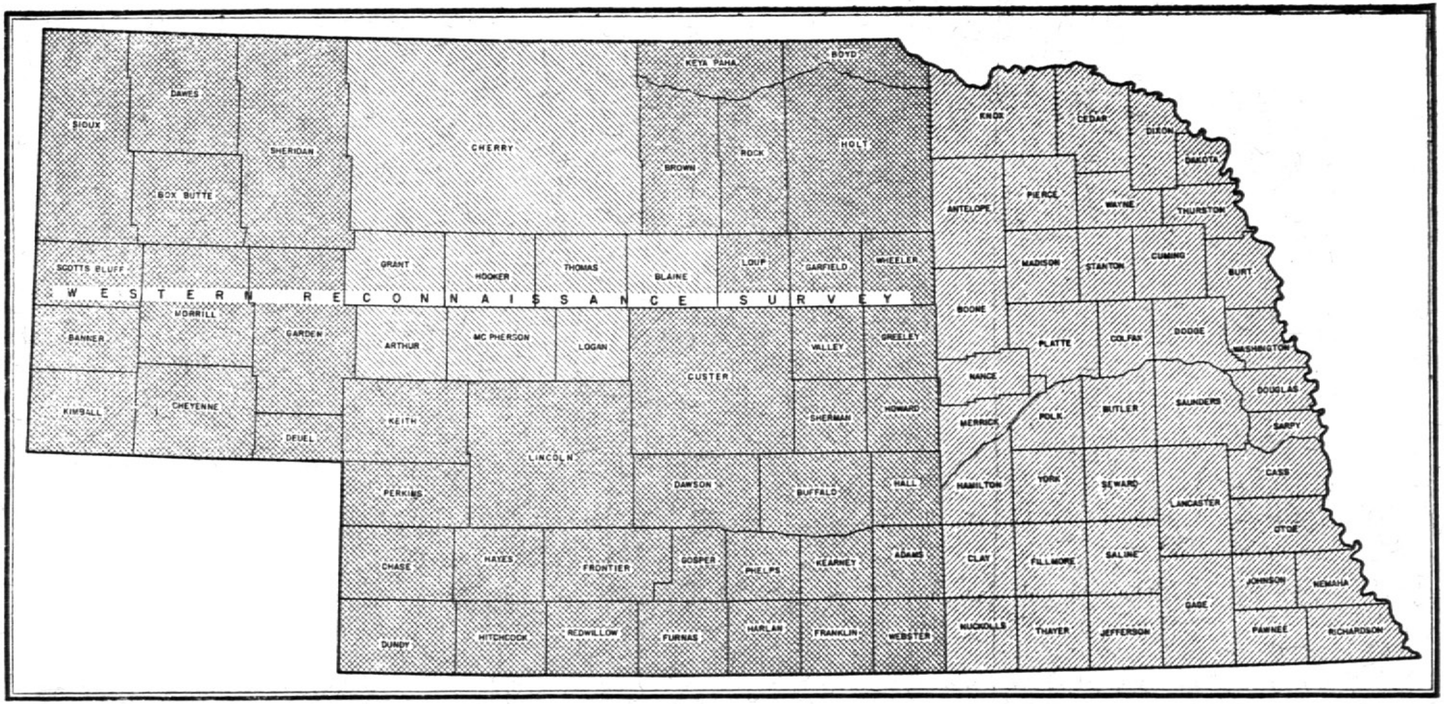

Areas surveyed in Nebraska shown by shading. Detailed surveys shown by northeast-southwest hatching; reconnaissance surveys shown by northwest-southeast hatching; crosshatching indicates areas covered in both ways.

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