

**UNITED STATES DEPARTMENT OF AGRICULTURE  
BUREAU OF CHEMISTRY AND SOILS**

In cooperation with the University of Nebraska State Soil Survey  
Department of the Conservation and Survey Division

**SOIL SURVEY  
OF  
FRANKLIN COUNTY, NEBRASKA**

BY

**F. A. HAYES, in Charge, and LOUIS A. WOLFANGER**  
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# SOIL SURVEY OF FRANKLIN COUNTY, NEBRASKA

By F. A. HAYES, in Charge, and LOUIS A. WOLFANGER, U. S. Department of Agriculture, and E. A. NIESCHMIDT, Nebraska Soil Survey

## COUNTY SURVEYED

Franklin County is in south-central Nebraska, adjoining Kansas. Franklin, the county seat, is about 160 miles southwest of Lincoln. The county is 24 miles square and comprises an area of 574 square miles, or 367,360 acres.

Franklin County is within the loess region<sup>1</sup> of Nebraska and includes parts of the loess plains and loess hills division. The loess plains division occupies about six townships in the northern and north-western parts and the loess hills division includes all the remainder of the county that is not occupied by alluvial deposits. The loess plains in general show very little difference in surface relief. They occupy nearly all of Lincoln and Salem Townships and in other sections of the county are confined to broad and narrow divides between drainage ways where erosion has not yet modified the generally flat surface of the old constructional plain. They range in general from almost level to gently undulating. Small basinlike depressions, locally known as lagoons or buffalo wallows, occur in some places.

The loess hills division includes the greater part of the county. Its relief is the result of stream erosion in the original plain and ranges from gently undulating to rough. The broad valley of Republican River crosses this division in the southern part of the county in a general east-and-west direction. The part lying north of this valley is larger in area than that to the south and is gently undulating or hilly, except where flat-topped spurs of the loess plains extend along the broader divides or where stream erosion has locally removed the loessial material, making the land somewhat rougher than usual. Tributary drainage ways to Republican River have carved rather deep and broad north-and-south valleys having gradual or steeply sloping sides. Most of the divides, however, even the narrower ones, are well rounded, and the general relief is not sharp or angular. Some soil slipping occurs and a few vertical exposures, locally known as catsteps, are to be seen on the steeper slopes.

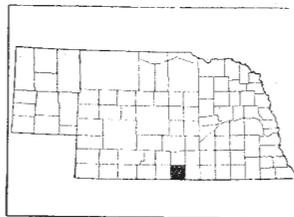


FIGURE 1.—Sketch map showing location of Franklin County, Nebr.

<sup>1</sup> CONDRA, G. E. THE SOIL RESOURCES OF NEBRASKA. Nebr. Conserv. and Soil Survey Bul. 15: 2-14. 1920.

A few of the larger tributaries in the northern part of the loess hills division have cut through the loessial mantle and exposed small areas of an underlying sand sheet. In such localities the relief is hummocky, owing to wind action which has whipped the loose incoherent sands into low mounds and ridges. In the southeastern part of the county Thompson Creek has locally cut through both the loessial mantle and the sand sheet, exposing the light-colored limy bedrock of the region. Continued erosion into this material has resulted in a very broken and rugged relief throughout a small area north of Riverton. However, by far the greater part of the loess hills division north of Republican Valley has a gently or strongly rolling surface.

That part of the loess hills division south of Republican Valley is more severely eroded than the area on the north side. In the eastern half the loess has been entirely removed except on a few of the higher divides. The sand sheet, if originally present, has also disappeared, and the drainage ways have cut deeply into the bedrock formation, resulting in areas ranging from gently rolling to extremely rough and broken. Most of the slopes are steep, and the divides, although broad in many places, are decidedly rolling. Exposures of the Tertiary and Cretaceous bedrocks produce many high and precipitous valley walls or occur as a rim rock on the valley sides.

The western half of the loess hills area south of the river is not so rugged as the eastern part. The loessial material has not been removed except in narrow strips along the deeper valleys, and rock cliffs or bluffs are of rare occurrence. The loess deposit has been greatly thinned by erosion, however, and is everywhere deeply carved by an intricate system of narrow steep-sided drainage ways. Most of the divides are sharp and crestlike, except locally in the southwestern part of the county where isolated outliers of the loess plains division occupy the broader ones.

The alluvial lands of Franklin County include the terraces and flood plains along Republican River and its larger tributaries. They range from a few rods to about  $2\frac{1}{2}$  miles in width. The terraces occur at several levels, depending on the depth to which the streams had cut prior to the deposition of the terrace materials.

The average altitude of Franklin County is about 2,000 feet above sea level, ranging from approximately 1,730 feet where Republican River crosses the eastern boundary to about 2,300 feet on the uplands in the extreme northwest corner. The average elevation of the loess plains division is about 2,200 feet, of the loess hills division 1,950 feet, and of the alluvial lands along Republican River 1,850 feet above sea level. The elevations of towns in the county are as follows: Hildreth 2,175, Upland 2,161, Campbell 2,000, Naponee 1,877, Bloomington 1,848, Franklin 1,820, and Riverton 1,768 feet above sea level<sup>2</sup>. The general slope of the county is to the south and east.

Well water of excellent quality is readily obtained in all parts of the county. The upland wells throughout the loess plains range from 125 to 200 feet in depth. In the loess hills few of the wells are more

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<sup>2</sup> GANNETT, H. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. U. S. Geol. Survey Bul. 274, Ed. 4, 1072 p. 1906.

than 125 feet deep, and in the alluvial lands an adequate water supply can be obtained at a depth ranging from 10 to 100 feet, depending on the thickness of the alluvial deposits. The wells on the terraces are deeper than on the bottom lands.

Native broad-leafed timber, consisting chiefly of willow, boxelder, elm, ash, and cottonwood, grows in narrow belts along most of the larger drainage ways throughout the county. Walnut, oak, and hackberry occur locally, and there is a scattering of cedar trees throughout a small area south of Franklin. Little of the timber is of merchantable size, but it is of value for firewood and posts.

The first permanent settlers in what is now Franklin County located in Republican Valley in 1870. Within the next few years settlement spread rapidly throughout the valley and uplands, and most of the county was included in homesteads. The early settlers were of many nationalities, although most of them were American born. The county was organized with its present boundaries in 1871.

According to census reports the population of the county was 5,465 in 1880, 7,693 in 1890, 9,455 in 1900, 10,303 in 1910, 10,067 in 1920. The population is all classed as rural. Outside of the towns, it is rather evenly distributed although it is slightly denser in Republican Valley and on the loess plains than throughout the loess hills division. The 1920 census gives the average density as 17.4 persons to the square mile.

Franklin, the largest town and county seat, had 1,055 inhabitants in 1920. It is in the south-central part of the county, is the main distributing center, and affords a good market for much of the surplus farm products. Smaller towns located along railroads throughout the county furnish local markets for farm implements, supplies, and produce.

Transportation facilities in Franklin County are good. The main line of the Chicago, Burlington & Quincy Railroad follows Republican Valley, and a branch of the same system crosses the northern part of the county. All parts of the county are within 12 miles of a shipping point.

The public-road system is well developed. All roads, except a few in the rougher parts of the county which conform to the topography for economic reasons, follow land or section lines. State and Federal-aid highways cross the county in two directions. These and the county roads between towns are graveled where necessary, kept well graded, and dragged after rains. Cement or steel bridges and culverts are common, even on secondary roads. Telephone lines and rural delivery routes reach all sections.

Surplus farm products are usually marketed outside the county. Most of the wheat, hay, dairy products, and livestock are shipped to Omaha or Kansas City. The greater part of the grain is delivered to local elevators where it may be sold at once or stored until the price is satisfactory. A flour mill at Naponee uses part of the wheat produced in that locality.

#### CLIMATE

The climate of Franklin County shows rather wide seasonal extremes. The winters are moderately long and cold, and the summers are hot. Cool weather, accompanied by considerable precipita-

tion, prevails in the spring. The fall season, which is usually long, is characterized by moderate temperatures and only occasional periods of rainy weather. The climate in general is favorable for stock raising and grain farming.

The data in Table 1, compiled from the records of the Weather Bureau station at Franklin in the south-central part of the county, are believed to be representative of prevailing climatic conditions.

TABLE 1.—Normal monthly, seasonal, and annual temperature and precipitation at Franklin

[Elevation, 1,820 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1907)	Total amount for the wettest year (1915)	Snow, average depth
	° F.	° F.	° F.	Inches	Inches	Inches	Inches
December.....	28.3	71	-25	0.71	0.60	0.55	4.9
January.....	25.0	76	-31	.40	.40	.51	3.2
February.....	28.4	81	-39	.68	.48	1.89	5.2
Winter.....	27.2	81	-39	1.79	1.48	2.95	13.3
March.....	39.1	96	-12	1.04	.71	2.39	6.0
April.....	51.5	98	6	2.38	.23	3.31	1.6
May.....	60.9	104	12	3.65	1.56	4.70	.5
Spring.....	50.5	104	-12	7.07	2.50	10.40	8.1
June.....	71.0	109	36	3.77	5.58	14.93	.0
July.....	76.4	112	43	3.35	.69	6.61	.0
August.....	75.6	114	36	2.78	1.29	2.60	.0
Summer.....	74.3	114	36	9.90	7.56	24.14	.0
September.....	66.9	113	19	2.67	2.46	1.71	(1)
October.....	53.4	97	6	1.50	.33	.43	.5
November.....	39.6	82	-24	.78	.18	.44	1.1
Fall.....	53.3	113	-24	4.95	2.97	2.58	1.6
Year.....	51.3	114	-39	23.71	14.51	40.07	23.0

<sup>1</sup> Trace.

Most of the summer rain falls as local thunderstorms. Droughts sometimes occur during July and August, but in general the rainfall is ample for the production of crops and is so distributed that, if moisture is properly conserved, crops seldom suffer severely from drought. Dry-farming methods which are commonly practiced in the western parts of Nebraska are not followed in Franklin County.

The average date of the last killing frost is May 5 and that of the first is October 4. This gives an average frost-free season of 153 days, which is ample for the maturing of ordinary farm crops. The date of the latest recorded killing frost is May 30 and of the earliest September 12.

The prevailing wind is from the northwest, except during the summer when the winds are usually from the southeast. High winds are common, but tornadoes are rare.

SOILS

The soil types, as identified and mapped in this region, are described and discussed in the following pages of this report. They are described in somewhat greater detail and their relationship to each other and the forces and processes of their development are brought out in pages 40 to 49. The distribution of the various soils is shown on the accompanying soil map, and their acreage and proportionate extent are given in Table 2.

TABLE 2.—Acreage and proportionate extent of the soils mapped in Franklin County, Nebr.

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Holdrege silt loam.....	133,440	} 38.1	Cass fine sandy loam.....	3,968	1.1
Rolling phase.....	6,720		Cass very fine sandy loam.....	4,288	1.2
Holdrege very fine sandy loam.....	5,568	1.5	Butler silt loam.....	832	.2
Colby silt loam.....	75,264	20.5	Nuckolls loam.....	1,280	.3
Colby very fine sandy loam.....	21,824	5.9	Derby sandy loam.....	6,848	1.9
Colby fine sandy loam.....	5,632	1.5	Bridgeport very fine sandy loam.....	960	.3
Colby loamy sand.....	3,328	.9	Bridgeport loamy fine sand.....	960	.3
Hall silt loam.....	8,512	} 5.0	Valentine sand.....	4,416	1.2
High-terrace phase.....	9,728		Bloomington silt loam.....	13,312	3.6
Hall very fine sandy loam.....	3,072	.8	Sogn silt loam.....	9,792	2.7
Hastings silt loam.....	16,768	4.6	Sogn gravelly loam.....	768	.2
Crete silt loam.....	5,440	1.5	Lamoure silt loam.....	1,280	.3
Fillmore silty clay loam.....	2,368	.7	Dune sand.....	704	.2
Judson silt loam.....	2,496	.7	Rough stony land.....	2,304	.6
Sarpy loamy sand.....	8,064	2.2	River wash.....	1,280	.3
Sarpy very fine sandy loam.....	2,816	.8			
Cass silt loam.....	3,328	.9	Total.....	367,360	-----

HOLDREGE SILT LOAM

The topsoil of Holdrege silt loam to an average depth of 18 inches is composed of three layers which differ considerably in structure. The upper layer, which is in few places more than 2 inches thick, is composed of loose, structureless, dustlike mulch, ranging in texture from silt loam to very fine sandy loam. The second layer, which is 3 or 4 inches thick, consists of silt loam having a platy or laminated structure. The individual plates are small, thin, and fragile. The third layer is similar in texture to the second but has a faintly granular or mealy structure. These three layers are friable, rich in organic matter, and prevailingly dark in color. The intensity of the color differs slightly in different layers, the laminated layer being the darkest and the structureless mulchlike covering the lightest. The organic constituents are very abundant in the first layer, but are not all thoroughly decomposed, and the soil material is dark grayish brown. In the granular layer decomposition of the plant remains is complete and the surfaces of the granules are almost as dark as the plates in the laminated layer. These three layers are characteristic of the topsoil in virgin areas of Holdrege silt loam in Franklin County. The upper two are completely destroyed in cultivated fields, but under prairie sod and normal moisture conditions they are very distinct and sharply defined. All topsoil layers break vertically into columns from 3 to 6 inches in diameter.

The fourth, or upper subsoil layer, lies between depths of 18 and 26 inches. It has a silty clay loam texture owing to the addition

of some fine material washed down from the overlying layers. Its basic color is grayish brown. On drying it cracks vertically into roughly shaped columns from 3 to 6 inches in diameter. This layer contains scattered worm casts and a few filled-in worm or insect cavities in which the material differs from the main soil mass in color, consisting either of dark-colored material from the overlying layers or of yellowish material from a lower layer. All the layers described have been leached of lime. The fifth layer is the one of maximum lime accumulation, it having received much of the lime from the overlying layers. It ranges in thickness from 4 inches to more than 2 feet and continues to an average depth of 40 inches. This layer consists of grayish-yellow or almost white loose floury silt containing an abundance of lime which appears as numerous seams, specks, and splotches, and also in finely divided form thoroughly mixed with the soil material.

Beneath the zone of maximum lime accumulation is the unweathered loess material from which the soil has weathered. It is composed of light grayish-brown, grayish-yellow, or in places almost white silt, which is even looser and more flourlike than the material in the fifth layer. It is rich in lime, but contains no white spots to indicate unusual concentration or segregation of the lime. This material extends downward without marked change to a great depth.

Holdrege silt loam shows only a few minor variations in Franklin County. Locally, on the shoulders of divides and on the steeper slopes, erosion has greatly thinned or entirely removed the dark topsoil layers, exposing the light-colored underlying material. Such areas, where sufficiently large to warrant mapping, are mapped with the Colby soils. In the more nearly level areas the compaction in the upper subsoil layer increases greatly, and in many places the Holdrege soils resemble the Hastings and merge into them so gradually that in many places it was necessary to draw arbitrary boundary lines. Practically the only variation in the surface soil is toward very fine sandy loam, and small patches of Holdrege very fine sandy loam are included, as are also narrow strips of alluvial and colluvial materials which occur along the smaller drainage ways.

Holdrege silt loam is the dominant soil throughout the loess plains division in the northwestern and north-central parts of the county. It also occurs on the flat-topped divides within the loess hills division. This soil occupies some of the highest positions in the county, occurring chiefly in those areas where the original constructional plain has been little modified by erosion. Areas range from almost level to rolling, but by far the greater part of the soil is undulating or gently rolling. Drainage is thorough, even the flatter areas having sufficient slope to carry off the surplus surface moisture and the porous subsoil affording ample underdrainage. In the more rolling areas, surface run-off is excessive on the steeper slopes and erosion is severe. In such places the Colby soils are gradually encroaching on the soil. Holdrege silt loam is retentive of moisture.

This soil is probably as strong and fertile as any of the upland soils in the Mississippi Valley. Crop yields, however, on account

of the lower rainfall in this section of the country, are usually much lower than those obtained on the better upland soils in the more eastern States. In seasons of heavy precipitation the yields of corn and alfalfa are from 50 to 75 per cent higher than in normal years. About 90 per cent of the soil is under cultivation. The remainder, including the more steeply rolling areas, is used for pasture land. The native vegetation includes a luxuriant growth of grama, buffalo, and June grasses, together with scant growths of bluestem and western wheatgrass. Corn, wheat, alfalfa, and oats are the leading cultivated crops, and most farmers grow small patches of rye, barley, sweetclover, millet, or Sudan grass for feed. Cattle raising is not practiced extensively, as most of the land is too valuable to be used for grazing purposes. A few farmers, however, have specialized in cattle feeding. Crop yields vary widely, depending on the rainfall. The average yield of corn and oats is about 25 bushels to the acre. Wheat yields from 10 to 30 bushels, with an average of about 14 bushels to the acre, and alfalfa from 2 to 3 tons of hay from three cuttings.

No definite system of crop rotation is practiced, although some farmers use indefinite systems subject to numerous substitutions. The more progressive farmers seem to favor a rotation consisting of corn 1 or 2 years, oats 1 year, wheat 1 or 2 years, and alfalfa from 3 to 5 years or as long as the stand remains profitable. On most farms the market demand is the controlling factor in crop rotation, and many tenant farmers grow the same grain crop for several successive years.

Soil of this kind is easily handled and can be cultivated without injury under a wide range of moisture conditions. If plowed when wet it has a tendency to form clods, but these are easily broken by harrowing the land or by allowing subsequent wetting and drying to restore granulation.

*Holdrege silt loam, rolling phase.*—The rolling phase of Holdrege silt loam occurs on slopes between the stream bottoms and the comparatively flat uplands occupied by the typical soil. It includes soils of all gradations between typical Holdrege silt loam and Colby silt loam. The surface soil is darker than the average for the Colby soil and ranges in thickness from 1 to 8 inches, depending on the extent of erosion. The thickness and character of the soil layers vary widely. The three layers of the surface soil are nearly everywhere present but are less perfectly developed than on the smooth upland. The fourth or upper subsoil layer is slightly less dense. Below this is the usual calcareous layer. In places the upper four layers are either thinly developed or absent. The most highly developed areas of this soil have a thin dark-colored surface soil overlying calcareous silt. Soil of this phase varies in agricultural value according to the smoothness of the land. The smoother areas yield nearly as well as the typical soil, but the more eroded areas can be used only for pasture.

The results of mechanical analyses of samples of the surface soil, subsurface soil, and several layers of the subsoil of typical Holdrege silt loam are given in Table 3.

TABLE 3.—*Mechanical analyses of Holdrege silt loam*<sup>1</sup>

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		<i>Per cent</i>						
376201	Surface soil, 0 to 6 inches.....	0.1	0.4	0.5	2.2	26.4	53.7	16.7
376202	Subsurface soil, 6 to 18 inches...	.0	.2	.2	1.6	20.4	51.7	25.8
376203	Subsoil, 18 to 26 inches.....	.0	.1	.1	.7	14.3	53.8	31.2
376204	Subsoil, 26 to 40 inches.....	.1	.0	.0	.5	10.5	61.7	27.1
376205	Subsoil, 40 to 121 inches.....	.0	.0	.0	.3	9.1	65.3	25.1
376206	Subsoil, 121 to 168 + inches....	.1	.2	.1	.7	15.3	60.8	22.7

<sup>1</sup> After treatment with hydrogen peroxide.

#### HOLDREGE VERY FINE SANDY LOAM

Holdrege very fine sandy loam differs from Holdrege silt loam only in the texture of the structureless mulchlike surface covering and the laminated or platy layer, both of which contain more very fine sand and less silt in the very fine sandy loam soil. The two soils merge so gradually where they are closely associated that it is practically impossible to bound them accurately on the map, and small areas of each soil are undoubtedly included with larger areas of the other in mapping.

Holdrege very fine sandy loam occurs only in a number of small bodies scattered throughout the loessial upland parts of the county. One of the largest areas, comprising about 800 acres, is in Lincoln Township a few miles southwest of Hildreth. A much smaller though typical body lies along the western county line 2 miles west of Naponee. Few of the remaining areas exceed 160 acres in extent. They occur chiefly within the drainage systems of Thompson, Center, and Cottonwood Creeks. Very little of this soil is mapped in the southern and northeastern parts of the county. Areas are flat or rolling. As much of the soil occurs on gentle upland slopes, the land surface is a little less even than that of Holdrege silt loam. Drainage is everywhere thorough, and in the more steeply rolling areas surface run-off is excessive and erosion is severe.

About 90 per cent of the soil is farmed. The remainder, including the rougher land, supports a luxuriant growth of the same grasses as grow on Holdrege silt loam.

Methods of management are about the same as for Holdrege silt loam, and the farmers recognize no difference in crop yields on the two soils.

#### COLBY SILT LOAM

The topsoil of Colby silt loam is loose structureless or semigranular silt loam from 6 to 8 inches deep. It ranges in color from dark grayish brown to ash gray, depending on the severity of erosion to which the soil has been subjected. The 3 or 4 inch surface layer is commonly considerably darker than the rest of the topsoil, owing to the presence of small amounts of organic matter. The subsoil is light-gray or yellowish-gray floury silt, which grades at a depth of about 20 inches into very light-gray or almost white parent loess. The subsoil and in many places the topsoil are highly calcareous, but the lime is evenly distributed throughout the soil mass.

This soil is simply loessial material, the surface layer of which has been slightly darkened by organic matter. It has not weathered sufficiently to have developed the layered or zonal profile so characteristic of the Holdrege soils nor has it accumulated so much organic matter in the topsoil. Much of it was probably originally Holdrege soil which lost most of its organic constituents through erosion. In areas where erosion has been especially severe, all organic materials have been removed as fast as formed and the parent loessial deposit is exposed in many places. In several small included areas the surface soil has accumulated considerable wind-blown sand and approaches very fine sandy loam in texture.

Colby silt loam is the dominant soil in the severely eroded loessial uplands. It occurs extensively around the southern and eastern borders of the main area of Holdrege soils and occupies the greater part of the loessial uplands south of Republican River. Areas range from steeply rolling to rough and dissected. The soil occupies steep or precipitous slopes and sharp divides between drainage ways. Drainage is everywhere thorough and in many places is excessive, causing erosion to be serious. However, where the surface run-off is artificially controlled, the soil is fairly retentive of moisture.

Colby silt loam as a whole is unfavorable to cultivation, but because of its large extent it is an important agricultural soil. About 50 per cent is in cultivated crops, and the remainder, including the rougher and more severely eroded parts, is used for pasture land. Some hay is cut on the narrow canyon floors and on the more gradual slopes. The native vegetation consists of a good growth of grama grass, buffalo grass, little and big bluestem, and many other nutritious pasture grasses. On the cultivated areas all farm crops common to the region can be successfully grown, although corn, wheat, and alfalfa are the most important. Oats, rye, sweetclover, sorghum, millet, and Sudan grass are minor crops. The soil is well suited to orchard fruits and berries, but as the climate is rather unfavorable for fruit, yields are uncertain. Wheat is the chief cash crop, although on farms where little livestock is kept most of the corn is sold. In the rougher sections the raising of beef cattle is an important industry. The animals are pastured during the summer and either sold to local feeders or shipped to Kansas City markets in the fall. Cattle are seldom run on the range during the winter, as is common in the more western counties of Nebraska.

Crop yields are governed largely by moisture conditions, the condition of the soil, and the care used in handling it. Owing to the lower organic-matter content of this soil, crop yields average somewhat lower than on Holdrege silt loam. Corn yields from 15 to 40 bushels with an average of about 20 bushels to the acre, wheat about 12 bushels, and alfalfa from 2 to 3 tons of hay from three cuttings. The high lime content and loose mellow consistence of the soil render it well suited to alfalfa, which retards erosion, adds nitrogen, and increases the naturally low organic-matter content. The average yield of oats is about 20 bushels and of rye 15 bushels to the acre. Rye is grown chiefly for late pasture but to some extent for the grain. The native grasses support from 150 to 200 head of livestock a section during the summer grazing season, which begins about May 15 and lasts until the middle of November.

Colby silt loam is easily handled, provided care is taken to prevent erosion. It clods a little if plowed when wet, but the lumps are easily reduced. Commercial fertilizers are not used. Barnyard manure is applied where available, but the supply is seldom sufficient for best results.

The prevention of excessive erosion is the chief problem in the utilization of this land, which in its virgin state is naturally productive. The relief is unfavorable for the accumulation of organic matter after the native sod is destroyed, and unless erosion is checked deep steep-sided gullies become so numerous as to prevent cultivation. Deep plowing, with the furrows following the contours of the slope, checks the velocity of the run-off and retards soil washing to some extent. Terracing the slopes, although rather expensive, is probably the best means of preventing erosion. Liberal applications of barnyard manure, straw, or other coarse vegetable matter should prove beneficial. The frequent growing of alfalfa, sweet-clover, or other legumes and the occasional plowing under of these crops will greatly aid in increasing the nitrogen and organic-matter content. The steeper slopes should probably be left in pasture, unless terraced or handled in such a way that alternating strips of sod and plowed land extend at right angles to the slopes. Where gullies have developed, dams of straw, wire, or rubbish held by posts will check the velocity of the surface run-off, thereby causing the water to deposit its sediment and gradually refill the depressions.

#### COLBY VERY FINE SANDY LOAM

Colby very fine sandy loam resembles Colby silt loam in all characteristics except the texture of the surface layer, which to a depth of 6 or 8 inches contains more of the finer grades of sand but less silt in the very fine sandy loam soil. The higher sand content of the surface layer of the very fine sandy loam is probably owing to the addition of wind-blown materials from the more sandy soils of the county.

Colby very fine sandy loam occurs in numerous areas throughout the eroded parts of the loessial uplands, in close association with Colby silt loam. Most of the tracts are small, few of them exceeding 320 acres. They are most numerous north of Republican River, along Thompson, Center, Cottonwood, and Turkey Creeks. Areas range from steeply rolling to rough and dissected but are not so rough as areas of the silt loam.

Drainage is everywhere thorough and in most places is excessive. Erosion is severe throughout most of the areas. The soil, however, is naturally retentive of moisture, and crops will withstand considerable dry weather provided surface run-off is artificially controlled.

Colby very fine sandy loam is of little agricultural importance in Franklin County on account of its unfavorable surface features. About 50 per cent of the land is under cultivation, and the rest is used for hay and pasture land. The soil is suited to all crops grown on Colby silt loam, and the farmers recognize no difference in crop yields or farming methods between the two soils.

## COLBY FINE SANDY LOAM

The topsoil of Colby fine sandy loam to an average depth of 6 inches is light grayish-brown or grayish-brown loose fine sandy loam. Below this depth the material gradually becomes lighter in color and finer in texture. Between depths of 12 or 14 and about 30 inches there is yellowish-gray very fine sandy loam. The lower subsoil layer, to a depth exceeding 3 feet, is light-gray or almost white very fine sandy loam containing an abundance of silt. The parent loess, a floury light yellowish-gray silt similar to that underlying the silt loam and very fine sandy loam members of the Colby series, begins between depths of 38 and 48 inches and continues to a great depth. Most areas of this soil have been more deeply leached of lime than the finer-textured members of the series, and the soil to a depth of 18 or 20 inches does not commonly effervesce with hydrochloric acid. The remaining layers, however, as well as the parent loess, are rich in lime occurring chiefly in finely disseminated form thoroughly mixed with the mineral constituents. The soil has undoubtedly weathered over loessial materials but has been greatly modified by sandy accumulations derived partly, through wind action, from the more sandy soils of the region and partly from the reassorted sandy strata within the loess itself.

The color of the topsoil varies somewhat with the surface relief. On the more nearly level areas conditions have favored the accumulation of some organic matter and the soil is dark, but on the steeper slopes and the crests of knolls and ridges, where the surface soil is exposed to wind and water erosion, organic matter is very scarce and the soil is light gray or almost white. Many small patches of Colby loamy sand have been included in mapping. In a few areas the material does not effervesce with hydrochloric acid within 3 or 3½ feet of the surface, but there is no evidence of a deficiency of lime.

Colby fine sandy loam occurs in numerous scattered areas throughout the eroded parts of the loessial deposits, chiefly on the north side of Republican River. One of the largest areas is on the east side of Turkey Creek in Farmers Township. Smaller though fairly typical tracts are in the uplands along Thompson, Center, and Cottonwood Creeks. Areas range from gently undulating to sharply rolling or hilly. Most of the soil either occupies gently or steeply sloping positions between the higher-lying silt loam or very fine sandy loam members of the Colby series and the alluvial lands along streams, or occurs on narrow rounded divides between drainage ways. The relief is in general less harsh and angular than that of the finer-textured members of the series, and soil slipping is unusual. The soil is well drained but, owing to the higher sand content and faster moisture-absorbing ability, is not subject to such serious erosion as Colby silt loam and Colby very fine sandy loam.

Owing to its small extent, patchy occurrence, and rather unfavorable relief practically all this soil is included in pastures. It is a fair farming soil, however, and in counties where it is more extensive it returns good yields of corn and alfalfa, where carefully managed. It is subject to slight drifting when the native sod is broken and requires some care to prevent excessive wind erosion.

The native vegetation consists of the same grasses as grow on Colby silt loam, with a higher proportion of bluestem and in addition considerable sand grass and stipa. These grasses support from 150 to 200 head of cattle a square mile during the summer grazing season.

#### COLBY LOAMY SAND

The topsoil of Colby loamy sand is light grayish-brown fine or medium sand from 6 to 8 inches deep. Though moderately well supplied with organic matter, it is in few places sufficiently rich in this material to prevent the soil from drifting when the native sod is destroyed. Throughout the remainder of the soil section the texture becomes gradually finer and the color lighter with depth until the very light-gray or almost white floury and silty parent loess is reached at a depth ranging from 3 to 5 feet. The lime has been leached to an average depth of 20 inches, but the lower subsoil layer is in most places calcareous and the parent loess contains an abundance of lime, occurring commonly in finely divided form, thoroughly mixed with the mineral elements. Scattered concretions may occur in the parent loess. Definite zones or layers such as occur in the Holdrege, Hastings, and Hall soils have not developed, and the soil is loose and rather incoherent throughout.

A few variations from typical occur. In the more level areas where conditions have been most favorable for the accumulation of organic matter, the topsoil is somewhat deeper and darker than typical, in many places extending to a depth of 10 inches. In the more exposed situations, however, as on steep hillsides or the crests of ridges, water or wind action has removed much of the organic matter and the soil is unusually light in color. Locally erosion has been so severe as to entirely remove the surface soil and subsoil, and the light-gray silty loessial material from which this soil has weathered is exposed. These variations are very numerous and aggregate a considerable area, but they occupy such small individual areas that it is not practical to show them on the soil map.

Colby loamy sand has weathered from loessial deposits the surface of which has been so deeply covered with wind-blown sand as to resemble aeolian material in most places. The sands came partly from the Valentine soils and partly from sandy strata within the loess.

Colby loamy sand occurs in only a few bodies of various sizes, chiefly within the drainage systems of Thompson and Center Creeks. One of the largest, comprising about 1 square mile, is an irregular-shaped area near the headwaters of Thompson Creek in Salem Township. A slightly smaller though typical area is on the north side of Center Creek in Ash Grove Township. Most of the remaining tracts are small. The relief ranges from choppy or hummocky to rather hilly. Even in the rougher sections, however, most of the slopes are gradual and the ridges and hilltops well rounded. The high sand content prevents the formation of a sharp angular relief, such as results when the finer-textured loessial soils become eroded. Areas are well drained, and in the more sandy or rougher areas drainage is excessive, owing either to the openness and porosity of the sands or to the rapidity of the run-off.

Colby loamy sand is of little agricultural importance in Franklin County on account of its small extent, comparative droughtiness, and susceptibility to soil drifting when brought under cultivation. Practically all of it remains with its native covering of grasses, chief among which are big and little bluestem, sand grass, and stipa, or needle grass. Small quantities of grama grass grow on the more level areas. Corn is grown in a few places, but the yields are usually low. The grazing of beef cattle is the principal industry. The native grasses support 90 or 100 head of cattle to the square mile during the summer grazing season.

It is doubtful whether much of this land should be brought under cultivation. It is a fairly good grazing soil but very difficult to handle when the native sod is destroyed. In areas now being farmed it is desirable to maintain a vegetal covering as much of the year as possible. Coarse manure and rotted straw are beneficial in preventing soil drifting. The soil should not be stirred more than is absolutely necessary in planting and cultivating. Corn and alfalfa do fairly well in favorable seasons, but the land is not suited to small grains.

#### HALL SILT LOAM

Hall silt loam consists of five rather well-defined layers, each of which occupies the same relative position in the profile and closely resembles the corresponding layer in the Holdrege soils. The Holdrege soils occur on the uplands and the Hall on the well-drained terraces.

Areas of Hall silt loam are very uniform throughout Franklin County. The different layers may differ somewhat in thickness, but they remain remarkably constant in most other characteristics. In a few places the zone of carbonate accumulation and the parent loessial deposit are separated by a layer from 6 to 15 inches thick of dark grayish-brown friable and finely granular silt loam which contains scattered specks and streaks of white lime. This layer appears to be an old weathered surface soil which was probably buried by later depositions. Locally noncalcareous reddish-brown very fine sandy loam or sandy clay loam occurs below a depth of 12 feet. As these variations are all developed below the main soil profile they are not indicated on the soil map.

Hall silt loam has developed over loessial sediments deposited in the flood plains of streams when they were flowing at higher levels. Later intrenchment has left these deposits as terrace or bench forms now lying from 8 to 30 feet above the present channels. Subsequent weathering and the incorporation of large amounts of organic matter have changed the original deposits to the present soil and given this soil a profile similar to that of the Holdrege soils.

Hall silt loam occurs in numerous areas of various sizes along most of the larger streams of the county. One of the largest areas occurs in the southeastern part as a narrow strip within the alluvial lands along Lohff Creek. A smaller though typical patch is on the south side of Republican River about 2 miles southwest of Bloomington. Areas are flat or very gently undulating except where traversed by drainage ways. In most places the land slopes gently down the valleys and toward the stream channels. Drainage is good but no-

where excessive. The slope is in most places sufficient to remove surplus surface waters, and the subsoil affords ample underdrainage. This soil is not subject to overflow from the main channels.

Hall silt loam is one of the most productive soils in Franklin County. It is naturally strong and fertile and withstands severe cropping, even under poor management, for several years. Practically all of it is under cultivation, except narrow strips along the highways and small bodies included in farmsteads. The native vegetation includes the grasses seen on the Holdrege soils. Corn, wheat, and alfalfa are grown extensively, and small patches of rye, barley, garden vegetables, and various forage crops are grown by most farmers for feed or household supplies. Crop yields average a trifle higher than on the Holdrege soils, as the lower position of Hall silt loam causes it to have a more uniform moisture supply. The average yield of corn is about 30 bushels to the acre, of wheat 15 bushels, of oats 30 bushels, of rye 20 bushels, and of alfalfa about 3 tons of hay from three cuttings. All crops yield from one-third to one-half more during seasons of high precipitation. Hogs are raised on nearly every farm.

Hall silt loam is easily handled and, considering its silty texture, can be cultivated under a rather wide range of moisture conditions. It forms clods if plowed when wet, but the lumps are easily reduced by harrowing. Alfalfa helps to maintain fertility, and the land is in no immediate danger of becoming exhausted. Barnyard manure is the only fertilizer used, and the supply is seldom sufficient to greatly increase the total crop yields.

Land of this kind sells at prices ranging from \$100 to \$125 an acre, depending largely on location and improvements.

*Hall silt loam, high-terrace phase.*—The high-terrace phase of Hall silt loam is identical with the typical soil in all features including profile, topography, drainage, origin, and mode of accumulation. However, it occurs on much higher and older terraces than Hall silt loam and for this reason is shown separately on the soil map. Areas lie from 90 to 100 feet above the present stream channels, and the parent loessial sediments were evidently deposited before the streams had cut deeply into the uplands.

Soil of this phase is more extensive than either Hall silt loam or Hall very fine sandy loam. It occurs only in the Republican River Valley and extends but a few miles up the tributary creeks. It lies chiefly on the north side of the river, where it forms an almost continuous strip across the county. Smaller areas lie south of the river in the vicinity of Riverton and Naponee. Crop yields and land values are similar to those on Hall silt loam.

#### HALL VERY FINE SANDY LOAM

Hall very fine sandy loam differs from Hall silt loam only in the texture of the two surface layers. The structureless mulch and the laminated layer both contain a little more very fine sand and a little less silt than the corresponding layers in the silt loam soil. Even these differences are not everywhere sufficiently pronounced to be easily recognized in the field, and patches of both soils are undoubtedly included within the larger areas of each, especially where areas

of the two soils join. Both soils have weathered from similar deposits.

Hall very fine sandy loam occurs in numerous patches and narrow strips within the alluvial lands of Republican River and its larger tributaries. Some of the largest areas are along Turkey Creek north of Naponee. Smaller though typical tracts lie along Thompson, Center, Little Cottonwood, Cottonwood, and Rebecca Creeks and in numerous places within the Republican Valley. Only a few areas exceed 160 acres in extent. The land is flat or very gently undulating. It occupies terrace or bench positions from 8 to 30 feet above the present stream channels. There is sufficient slope down the valley and toward the streams to give ample surface drainage, and the subsoil affords good underdrainage. The soil is not subject to destructive erosion.

Crop yields and farming methods are similar to those on Hall silt loam, and farmers recognize no difference in land values.

#### HASTINGS SILT LOAM

Hastings silt loam is intermediate in profile characteristics between Holdrege silt loam and Crete silt loam. The dark friable topsoil extends to a depth of about 24 inches. In uncultivated areas it consists of three layers or horizons similar to those in the soils mentioned, a loose surface mulch from one-half to 2 inches thick, a laminated or platy layer from 3 to 6 inches thick, and a granular layer. All these layers are composed largely of silt, although they contain some very fine sand and considerable organic matter, which produces the dark color. The subsoil consists of two layers which are separated by transitional material. The upper layer, or the fourth from the surface, is the layer of maximum compaction. It ranges from 10 to 14 inches in thickness and is moderately compact heavy silt loam or silty clay loam which breaks vertically into columns from 4 to 6 inches in diameter. The columns have numerous horizontal seams, cracks, and lines of weakness and break naturally into more or less prismatic units, few of which exceed one-half inch in their longer or vertical dimension. This layer is grayish brown or light brown, that is, considerably lighter in color than the granular layer owing to the thinning, with depth, of the organic-matter film which covers the structure particles. Although much more compact than the corresponding layer in Holdrege silt loam this layer does not attain the density of a claypan. The transitional material of the subsoil is columnar but otherwise structureless silt or silty clay which overlies the lime zone. It is dark grayish brown and moderately compact in the upper part but is grayish-yellow floury silt in the lower part. It ranges from 8 inches to 3 feet in thickness but in most places gives way to the lime zone at a depth of about 5 feet. The lime zone or lower subsoil layer is light grayish-yellow or almost white loose columnar silt containing an abundance of lime in several forms. The silt has no definite structure but breaks into irregular-shaped clods of various sizes.

Beneath the lime zone is the unweathered or only slightly modified loessial formation from which Hastings silt loam has developed.

The loess is typically more or less calcareous, but its lime content per unit of volume is less than that of the lime zone.

Scattered throughout the soil are worm casts and borings. The casts are small pellets of soil from one thirty-second to one-eighth inch in diameter. In most places they are most numerous in the granular layer where they may occur singly, in groups ranging from 10 to 25 individuals, or as filling material in old root, worm, or insect cavities. The color and texture are similar to those of the surrounding soil mass. The borings are twisted rodlike forms about one-fourth inch in diameter and from 1 to 4 inches in length. They also seem to be fillings within worm, root, or insect cavities but are generally slightly more compact than the surrounding soil matrix and slightly lighter or darker in color, the shade probably depending on whether the filling material came from layers above or below. The borings are most numerous in the upper subsoil layer but are more or less abundant in all layers beneath the laminated one.

Hastings silt loam is remarkably uniform. In cultivated fields the structureless and laminated layers have become mixed by tillage operations and their identity destroyed, the surface layer in such localities consisting of loose structureless or very faintly granular mulchlike material 4 or 5 inches thick. This layer rests on the granular layer of the lower topsoil. Another variation from typical is in the upper subsoil layer, which becomes unusually friable adjacent to areas of Holdrege soils and in many places differs so little from the upper subsoil layer of Holdrege silt loam that accurate mapping is extremely difficult.

Hastings silt loam occurs in numerous scattered areas of various sizes throughout the upland plains in the northern and eastern parts of Franklin County. The largest area, comprising about 6 square miles, lies along the eastern county line. Typical areas occur northeast of Upland, north of Campbell, southeast of Macon, and south of Hildreth. This soil occupies some of the highest positions in the county. Areas are nearly level or very gently undulating, averaging slightly more level than the Holdrege soils.

The soil is naturally well drained. The subsoil is not sufficiently compact to hinder free downward movement of soil moisture and the slope is sufficient, even on the more nearly level areas, to carry off surplus surface water.

Probably 95 per cent of the land is under cultivation, and the remainder is included in small pastures and building sites. Corn, wheat, oats, and alfalfa are the leading crops, ranking in acreage in the order named. This is one of the best upland soils in Franklin County, being equal to Holdrege silt loam in productiveness. In fact, farmers recognize no difference in crop yields between the Hastings and Holdrege silt loams, and the two soils are handled in the same manner. The relief of the Hastings soil is as a whole probably better suited to the use of large machinery.

In Table 4 are shown the results of mechanical analyses of samples of the surface soil, subsurface soil, and several layers of the subsoil of Hastings silt loam.

TABLE 4.—*Mechanical analyses of Hastings silt loam*<sup>1</sup>

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		<i>Per cent</i>						
376207	Surface soil, 0 to 1 inch.....	0.1	0.5	0.5	0.7	12.8	64.0	21.4
376208	Subsurface soil, 1 to 6 inches...	.0	.2	.3	1.9	13.3	60.8	23.4
376209	Subsoil, 6 to 15 inches.....	.0	.1	.1	.8	12.6	54.1	32.3
376210	Subsoil, 15 to 22 inches.....	.0	.1	.1	.5	10.3	42.8	46.1
376211	Subsoil, 22 to 39 inches.....	.0	.1	.1	.5	2.4	42.0	54.8
376212	Subsoil, 39 to 54 inches.....	.0	.1	.1	.8	16.8	63.8	18.3
376213	Subsoil, 54 to 118 inches.....	.0	.0	.0	.3	12.6	67.2	19.8
376214	Subsoil, 118 to 156 inches.....	.0	.1	.0	.3	14.1	63.6	21.7

<sup>1</sup> After treatment with hydrogen peroxide.

## CRETE SILT LOAM

Crete silt loam occurs on the nearly level but well-drained uplands of the county. It is readily identified by the dark grayish-brown color and compact claypanlike character of its upper subsoil layer. Under native sod the soil is composed of five rather well-defined layers or horizons. The upper three, which comprise the topsoil, are very dark grayish brown or almost black, friable, and rich in organic matter. They have a combined thickness of about 20 inches and include a surface mulch, a laminated layer, and a granular layer. These layers are very similar to the corresponding layers of Holdrege silt loam. The subsoil consists of two layers, a brown very compact layer and a light-gray friable layer, both of which are rather low in organic matter. The compact layer is about 20 inches thick and lies immediately below the granular layer. It is composed largely of clay, is plastic when wet, and becomes very hard and tough when dry. The material when dropped breaks into irregular-shaped clods of various sizes. This layer is readily identified by its dense or claypanlike consistence and is known by the farmers as the brown gumbo layer. Exposures of the claypan in dry road cuts present a coarse network of fine seams and cracks caused by shrinkage of the clay. This layer, which greatly retards water movement and is extremely resistant to penetration, extends to an average depth of 40 inches. The lower subsoil layer or the light-gray friable layer is composed largely of loose floury silt. It is about 30 inches thick and may be regarded as the lime zone, owing to the presence of white specks, splotches, and small hard or semihard lumps of lime. The specks and splotches are most abundant in the upper 10 or 12 inches of the layer and decrease gradually with depth, entirely disappearing at a depth of about 70 inches. The lime zone is very low in organic matter.

Beneath the lime zone is the geologic formation from which the soil has weathered. It is yellowish-gray, loose, floury silt, locally called yellow clay but known in the Nebraska surveys as loess. This material is very uniform in composition to a great depth. In many places it is exposed in deep road cuts or severely eroded hill-sides throughout the uplands. The loess underlying Crete silt loam is very low in lime to a depth below 15 or 20 feet.

Borings and worm casts are numerous in the granular layer and are scattered through the lime zone but are very scarce in the claypan.

The profile described is typical of Crete silt loam where the soil has attained its maximum development. However, this soil in Franklin County is near the western extremity of its range and much of it has not developed such an extremely dense claypan as occurs in counties to the east. The claypan throughout several areas is only a little more dense than the layer of maximum compaction in the Hastings soils, but because of its lack of either the columnar form or cubical or prismatic-shaped structure particles so characteristic of the corresponding layer in true Hastings soils, it was classed in the Crete series. In cultivated areas the structureless surface mulch and laminated layers have become mixed by tillage and have lost their identity.

Crete silt loam occurs scattered throughout the nearly level uplands in the north-central part of the county. One of the largest areas, comprising about 1,000 acres, is in the vicinity of Upland, another is about 3½ miles southeast of Hildreth, and smaller though typical areas are southeast and east of Upland, south of Hildreth, and in the vicinity of Macon. The soil occupies practically level or slightly depressed flats. Even the depressions, however, have drainage outlets, and surface run-off, although very slow, is adequate. Underdrainage is restricted by the claypan.

Owing to its small extent this soil is of little agricultural importance in Franklin County. It is as strong and fertile as the Holdrege and Hastings soils and practically all of it is under cultivation. Its readily available moisture supply, however, is limited to that part of the soil above the claypan, and in dry years crops sometimes suffer for water.

Small grain is grown chiefly. Wheat is especially suited to the soil, as this crop usually matures before the dry windy weather of mid-summer and requires less moisture than corn or alfalfa. Both corn and alfalfa, however, are grown and in average years yield as well as on Holdrege silt loam. In dry years the yields are about two-thirds as large as on the Holdrege and Hastings soils.

Crete silt loam is easily handled, considering its fine texture. Clods are formed if the land is cultivated when wet, but the lumps are easily reduced by harrowing or disking and the soil can be kept in good tilth with ordinary care. It is not so well suited to a diversity of crops as the more friable upland soils but its level surface favors the use of large machinery. The land is valued as highly as soils of the Holdrege and Hastings series.

#### FILLMORE SILTY CLAY LOAM

Fillmore silty clay loam is an upland soil with a black claypanlike layer in the upper part of the subsoil. The soil has weathered under comparatively poor drainage conditions. The topsoil is friable and ranges from less than 6 to about 14 inches in thickness. Where thinnest it is commonly composed of two layers, the upper consisting of dark grayish-brown semigranular heavy silt loam 1 or 2 inches thick and the lower of moderately heavy silty clay loam which may be almost black or light gray, depending on drainage conditions. In well-drained areas this layer is generally very dark, but in poorly drained areas it may be almost white. It is generally laminated or similar in structure to the second layer of the Holdrege, Hastings, and Crete

soils. Where the topsoil is thickest the upper two layers are very dark, and a third layer, from 3 to 10 inches thick, is developed. This layer is friable imperfectly granular and almost black silt loam in the upper part and is more or less sprinkled throughout with white floury silt which becomes increasingly abundant with depth and in many places conceals the naturally dark color of the lower granules. In the more poorly drained situations the white silt may become so abundant as to form a thin, usually laminated fourth layer beneath the granular material. However, this layer does not ordinarily increase the average total thickness of the topsoil, as the third or semi-granular layer is thinner where the fourth occurs. The white floury silt somewhat resembles volcanic ash and is so called by many farmers. It has no abrasive qualities, however, and is simply a product of soil weathering which develops under poor drainage conditions in the Fillmore soils.

Beneath the variable topsoil is the subsoil composed of two layers. The upper one is black structureless clay ranging from 12 to 24 inches in thickness. It is a true claypan, being extremely compact and comparatively impervious. It contains scattered black hard concretionary forms which are round or nearly round and are from one-eighth to slightly more than one-fourth inch in diameter. The lower subsoil layer is characterized by its high lime content. It is structureless grayish-brown silt, moderately compact in the upper part where it joins the claypan but rapidly becoming lighter in color and more flourlike with depth. Visible lime, chiefly in the form of concretions, spots, and splotches, is abundant in the upper 8 to 12 inches of the layer but gives way to finely disseminated lime at a depth of about 5 feet. All traces of lime disappear at a depth of 6 or 7 feet. Beneath the lower subsoil layer is loess, a yellowish-gray floury siltlike deposit containing scattered rust-brown stains and spots but no lime in the upper 4 or 5 feet. This is the formation from which the soil has weathered.

Except for the variations in the topsoil, Fillmore silty clay loam is fairly uniform. One subsoil variation, however, occurs south of Macon in the largest area of this soil and in a few of the smaller areas scattered throughout the uplands. In these tracts the subsoil apparently contains two extremely compact claypan layers, one above the other. The upper one is brownish black and the lower one dense black. They have a combined thickness of about 40 inches, the darker layer being slightly thicker and containing practically all the black round concretionary forms occurring in this soil. The lime zone, which lies below a depth of 5 feet, has an average thickness of 12 inches.

Fillmore silty clay loam occurs in numerous depressions throughout the more level plains in the northern part of the county. The largest area is south of Macon. A somewhat smaller though more typical tract is  $4\frac{1}{2}$  miles southwest of Hildreth. Other areas are small.

This is the most poorly drained of the upland soils. The depressions have no surface drainage, and water accumulated after heavy rains is removed slowly by evaporation. Owing to the moderate rainfall of the region, however, the basins are dry the greater part of each year.

Fillmore silty clay loam is of little agricultural importance in Franklin County. Practically all of it is used for pasture and hay land. Several of the smaller areas are included in cultivated fields but are usually regarded as waste land and are not seeded to grain crops.

The native vegetation includes a variety of moisture-loving grasses in the lower situations and buffalo, grama, and wheat grasses in the drier areas. The soil as a whole is excellent hay and pasture land. The quality of the grasses, however, could be greatly improved in many places by sowing timothy and clover among the native grasses.

#### JUDSON SILT LOAM

The most striking characteristic of Judson silt loam is its uniformity to a depth of 5 or 6 feet. It consists of very dark grayish-brown mellow silt loam or very fine sandy loam which continues with little change throughout the entire soil, though the surface 6 or 8 inches may be slightly darker than the remainder of the soil owing to a larger organic-matter content. The soil throughout is rich in well-decomposed plant remains and is very low in lime.

Judson silt loam is very uniform in Franklin County. However, the material in many places contains so much sand of the finer grades as to assume a very fine sandy loam texture. This variation, although rather extensive, is of little agricultural importance. In a few places structural layers are apparently beginning to develop. The surface 4 or 5 inches has a rather indefinitely laminated appearance, and the remainder of the soil is more or less granular.

This soil has developed over a mixture of fine sediments derived through surface wash and colluvial action from the surrounding uplands and deposited within the narrower stream valleys. It has not weathered sufficiently to have developed the layered or zonal profile characteristic of mature soils. The dark color of the entire soil is owing to the high organic-matter content of the original sediments and not to the accumulation of plant remains subsequent to their deposition.

Judson silt loam occurs principally in narrow strips along Little Blue River and Thompson Creek and a few of their larger tributaries. The land is smooth, with a gentle slope down the valleys and toward the stream channels. Drainage is good, as the slope is sufficient to remove surplus surface waters and the subsoil affords ample underdrainage. Areas of this soil lie from 12 to 18 feet above normal stream flow and are not subject to inundation from the main channels. No part of the soil is severely eroded.

Nearly all this soil is under cultivation. Wheat, corn, oats, and alfalfa are the principal crops, and vegetables and forage crops are grown in sufficient quantities for livestock feed and household needs. Crop yields and the methods of handling the land are about the same as on Hall silt loam.

#### SARPY LOAMY SAND

The topsoil of Sarpy loamy sand is grayish-brown or light grayish-brown loamy sand from 5 to 8 inches deep. It is composed largely of fine sand and very fine sand with barely sufficient silt, clay, and organic matter to give it a loamy texture and not enough to

stabilize the sand and prevent drifting when the native sod is destroyed. The upper subsoil layer, which extends to a depth of about 2 feet, is slightly lighter-colored and more coherent friable fine sandy loam with a high silt content. It rests on loose incoherent gray sand which continues below a depth of 5 or 6 feet with little change. This soil is more or less calcareous throughout. The organic matter decreases rapidly with depth and is practically absent below a depth of 2 feet.

The soil has developed over sandy alluvial sediments recently deposited in the present flood plains of the streams. Subsequent weathering and the accumulation of small amounts of organic matter in the surface layers has resulted in the present soil.

The principal surface variations are toward sand and fine sandy loam. The sand texture is characteristic of the low rounded knolls where wind action has largely removed the organic matter and fine material, and fine sandy loam occurs in many of the numerous small pockets or depressions where conditions have been most favorable for undisturbed weathering and the accumulation of organic remains. In such localities the material greatly resembles river wash. It is, however, less affected by each slight rise of the streams, has a somewhat darker and deeper surface layer, and is considerably more stable. In many places rust-brown iron stains occur below a depth of 2 feet.

Sarpy loamy sand is the dominant light-colored bottom-land soil along Republican River, where it occurs in strips ranging from one-fourth to about 1 mile in width on both sides of the channel. The longer and wider areas are most numerous on the north side of the stream. Strips are also along many of the tributary creeks north of the river. Areas are flat or gently undulating, being characterized in most places by low rounded hummocks, ridges, or slight elevations with intervening shallow depressions. Commonly the slope down the valley and toward the streams is gentle. As this soil lies only 3 or 4 feet above the normal stream flow it is subject to inundation during periods of high water. Surface drainage is poorly established, but the porous sands rapidly absorb and carry off the surplus moisture and water seldom remains on the land more than a few hours after the streams subside. In average years the underlying water table is rather near the surface and keeps the subsoil moist. However, the soil is not retentive of moisture and in dry years when the water table becomes lower it is very droughty.

Sarpy loamy sand is probably the most important bottom-land soil in Franklin County but is not so fertile as the Cass soils and is even less coherent than Sarpy very fine sandy loam. About 60 per cent of it is under cultivation, and the rest remains with its native grass covering and is used for grazing land. The principal crops are corn and alfalfa. Crop yields average slightly lower than on Sarpy very fine sandy loam. Bluestem and sand grasses comprise most of the native vegetation, although sand burs are common and in many places become troublesome weeds in both fields and pastures. Areas bordering the streams support a growth of willow, cottonwood, elm, ash, and boxelder trees. The native grasses maintain from 50 to 60 head of cattle to the quarter section (160 acres) during

the summer grazing season, or when cut for hay yield from one-half to three-fourths ton to the acre, depending on moisture conditions.

Soil of this kind is easily handled and can be cultivated under practically all moisture conditions, provided care is taken to prevent soil drifting.

#### SARPY VERY FINE SANDY LOAM

The topsoil of Sarpy very fine sandy loam consists of loose friable grayish-brown or light grayish-brown very fine sandy loam from 6 to 12 inches deep. Its color indicates a low organic-matter content. The upper subsoil layer, which continues to a depth of about 18 inches, is similar to or slightly lighter in color than the surface layer and consists of loose fine sandy loam which contains sufficient silt to make the material moderately coherent. This layer rests on very light-gray incoherent fine or medium sand which continues to a great depth. The organic matter, nowhere abundant even in the topsoil, decreases rapidly with depth and is scarcely noticeable below a depth of 20 inches. Most areas of this soil are calcareous throughout, and in many places the subsoil contains an abundance of disseminated lime.

Areas of Sarpy very fine sandy loam differ somewhat from place to place. The surface soil ranges in texture from silt loam to fine sandy loam. In many places the upper subsoil layer contains an unusually large amount of silt and is considerably more coherent than the corresponding layer in the Sarpy soils along Platte River. This soil in Franklin County differs from Sarpy very fine sandy loam in the Platte Valley, also in the absence of coarse sand and gravel below a depth of 3 or 4 feet. There is very little coarse material in any of the alluvial soils in Franklin County.

Sarpy very fine sandy loam occurs in numerous small areas and narrow strips within the flood plains of Republican River and in a few areas along Thompson and Turkey Creeks. Areas are in general flat, although the surface may be modified by stream channels, cut-offs, slight elevations, and shallow depressions. As a whole the soil is well drained during average seasons. It lies but a few feet above normal stream flow, however, and is subject to inundation during periods of high water. The slope is sufficient in most places to remove the surplus moisture after the streams subside, and the porous sands afford ample underdrainage. As this soil has low moisture-retaining power, it is more or less droughty during dry weather.

About 70 per cent of this soil retains its native grass covering. The remainder is used chiefly in the production of corn and alfalfa. Some truck crops, including watermelons, cantaloupes, tomatoes, and cucumbers, are grown. The land is admirably suited to truck crops, as the soil is loose and friable and can be worked early in the spring. However, the market for truck crops is limited.

Corn yields an average of 18 bushels to the acre and alfalfa 2½ or 3 tons of hay from three cuttings. In unusually wet weather or during prolonged droughts yields of all crops are materially reduced. The native grasses support a cow or horse on each 2 or 3 acres during average seasons, or when cut for hay yield from one-half to three-fourths ton to the acre.

## CASS SILT LOAM

Cass silt loam differs from Cass very fine sandy loam only in the slightly higher silt content of the surface soil. The variations included in one soil occur to greater or less extent in the other.

This soil has weathered from sandy alluvial sediments in the same manner as the other Cass soils. The silty texture of the surface layer may be owing partly to assortment by the streams and partly to fine deposits washed in from the higher-lying soils.

Cass silt loam occurs chiefly on the flood plains of Republican River, but a few areas are along Thompson Creek in the east-central part of the county. One of the largest areas, comprising about 480 acres, lies south of Republican River in the vicinity of Reams School. A small though typical tract is south of Naponee on the north side of the stream. This soil occurs mainly in close association with other members of the Cass series. Most areas are more depressed or more level than areas of the other Cass soils, and the land is more poorly drained. The porous subsoil, however, absorbs most of the surplus moisture except during seasons of heavy precipitation when the water table is high. About 50 per cent of the land can be farmed without resorting to artificial drainage. The remainder is excellently suited to hay production and to use as grazing land. The grass growth, more luxuriant than on most of the other bottom-land soils, supports a cow or horse on each acre during the summer grazing season or yields about 1 ton of hay to the acre.

Corn and alfalfa are the leading cultivated crops. Corn yields an average of about 25 bushels to the acre and alfalfa about 3 tons of hay. Alfalfa is usually cut three times, and in favorable seasons a fourth cutting is sometimes obtained.

Land of this kind sells at about the same prices as Cass very fine sandy loam. Most of it is sold in connection with other soils.

## CASS FINE SANDY LOAM

Cass fine sandy loam differs from Cass very fine sandy loam only in the coarser texture of its surface layer, which consists of very dark grayish-brown loose fine sandy loam from 6 to 12 inches thick. This is underlain by grayish-brown loamy sand to a depth of about 18 inches, and this layer, in turn, rests on very light-gray almost pure fine or medium sand which continues beyond a depth of 5 or 6 feet. The topsoil contains an abundance of organic matter and sufficient silt and clay to make it very coherent. The upper subsoil layer has a low organic-matter content, but the finer-textured mineral constituents are slightly more abundant than in the surface layer. The two horizons have about the same consistence. The underlying sandy material contains practically no silt, clay, or organic matter and is very loose and incoherent. In most places the soil is calcareous throughout, the lime existing in finely divided form thoroughly mixed with the mineral and organic constituents.

A few local variations from typical occur in mapped areas of this soil. The principal variation in the surface soil is toward sandy loam and very fine sandy loam. In many places the dark-colored topsoil rests directly on light-gray incoherent sand at a depth of about 12 inches. Elsewhere, the subsoil may be composed

of alternating layers of fine or coarse sand and silt underlain by gray fine or medium sand at a depth of 3 or 4 feet.

Cass fine sandy loam has weathered from coarse-textured sands rather recently deposited in the flood plains of streams. The areas are generally flat, although modified in places by slight elevations, shallow depressions, and old stream channels. Most of the land lies slightly higher than Cass very fine sandy loam, and the soil as a whole is better drained. In wet years, however, the water table rises within 3 feet of the surface in many localities, and in a few places the soil remains too moist for profitable farming. In dry seasons underdrainage is excessive in many places, and crops do not thrive so well as on the soils with heavier subsoils.

This soil occupies bottom-land or flood-plain positions along Republican River and a few of its larger tributaries, occurring in close association with Cass very fine sandy loam.

Owing to its small extent this soil is of little agricultural importance in Franklin County. About 60 per cent of it is under cultivation, mainly to corn and alfalfa. The remainder is used for hay and pasture land. Crop yields are about the same as on Cass very fine sandy loam. The soil is not suited to small grain, on account of the difficulty in obtaining a firm seed bed. The native vegetation consists of a rather rank growth of prairie and marsh grasses which support a cow or horse on each 2 acres during the summer grazing season.

#### CASS VERY FINE SANDY LOAM

The topsoil of Cass very fine sandy loam is dark grayish-brown loose friable very fine sandy loam, from 8 to 15 inches deep. When wet this layer is almost black. It contains considerable silt and only a small percentage of particles coarser than very fine sand. The material is rich in well-decomposed organic remains, which cause the dark color. The subsoil is variable, but in all places contains less organic matter and more sand than the topsoil. Most of it consists of grayish-brown fine sandy loam to a depth of about 2 feet, and below this depth of very light-gray incoherent fine or medium sand, which remains fairly uniform beyond a depth of 5 or 6 feet. The subsoil is generally calcareous, and even the topsoil in some places effervesces with hydrochloric acid. Below a depth of 24 inches this soil is very low in organic matter. Rust-brown iron stains are common throughout the lower part of the subsoil.

In some included areas the sandy subsoil contains an unusually large proportion of silt and clay and the material has a rather sticky, gritty feel when wet and can be broken into moderately hard clods when dry. In many places the subsoil is composed of alternate layers of silt and various grades of sand, and locally a thin layer of dark grayish-brown or almost black very fine sandy loam lies at a depth of about 2½ feet. The principal textural variation is toward silt loam and fine sandy loam.

This soil has weathered from sandy alluvial materials deposited in the bottom lands along the streams during periods of high water. The high organic-matter content of the surface horizon is caused by the growth and decay of vegetation.

Cass very fine sandy loam occurs in numerous areas within the flood plain of Republican River and as narrow strips adjacent to

the channels of the larger tributary creeks north of the river. One of the largest areas, a body about 3 miles long and ranging from one-fourth to about one-half mile in width, is along Turkey Creek in the western part of the county. Areas are prevailingly flat except where relieved by old stream channels, cut-offs, and low mounds or ridges. Drainage is variable. As the land lies but a few feet above normal stream flow it is in many places subject to overflows during high-water periods. In wet years the underlying water table is near the surface and the subsoil remains constantly moist. In dry seasons the water table becomes lower, and since the sands are not retentive of moisture the soil becomes somewhat droughty. During average years, however, moisture conditions are favorable for crop production.

Owing to its small extent and variable drainage this soil is of little agricultural importance in Franklin County. About 60 per cent of it is under cultivation, and the remainder, including the more poorly drained areas, is used for pasture and hay land. The native vegetation consists of a rather rank growth of moisture-loving grasses and sedges which support a cow or horse on each acre during the summer grazing season or when cut for hay yield three-fourths or 1 ton to the acre. The hay is of coarser texture and lower feeding value than that cut from the better-drained upland and terrace soils.

Corn and alfalfa are the most important cultivated crops. Corn yields from 20 to 35 bushels to the acre and alfalfa  $2\frac{1}{2}$  or 3 tons of hay from three cuttings. Alfalfa is especially well adapted to this soil, even during prolonged droughts, as the long roots usually extend downward to the water table. Hay grasses produce well. The quality of the wild hay could be greatly improved by sowing timothy and clover seed among the native grasses.

#### BUTLER SILT LOAM

Butler silt loam is transitional between Crete silt loam and Fillmore silty clay loam. The topsoil is composed of three persistent layers and is similar to that of Crete silt loam except that the lower or granular layer is somewhat thinner and in many places more or less sprinkled with almost white floury silt. The light-colored silty material is most abundant in the lower part of the layer and in some places it may form a thin fourth layer of loose, floury, usually laminated silt beneath the granular material. The subsoil consists of two layers. The upper one is very dark grayish-brown or black heavy compact clay similar in color, structure, thickness, and compaction to the claypan layer in Fillmore silty clay loam but containing none or very few of the black, round, concretionary forms so characteristic of that layer. The black concretions present are much softer and smaller than in the Fillmore soil, few exceeding one-sixteenth inch in diameter. The lower subsoil layer is the zone of lime accumulation. It begins at a depth between 36 and 40 inches and is from 30 to 50 inches thick. The material is very similar to that of the lime zone of Fillmore silty clay loam. Concretions, splotches, and specks of white lime are abundant in the upper 12 or 14 inches, and the lower part of the layer contains more or less finely divided lime which decreases with depth, disappearing entirely at a depth ranging

from 6 to 8 feet. Beneath the lower subsoil layer is yellowish-gray floury silty material commonly called yellow clay but known to the State geologists as loess. It is the formation from which the soil has developed and contains no lime in its upper 4 or 5 feet.

Butler silt loam occurs in numerous small depressions scattered throughout the more nearly level upland plains in the northern part of the county. One of the largest areas, comprising about 160 acres, is 2½ miles southeast of Macon. A smaller though typical tract is 5 miles south of Upland. The depressions are without surface drainage, and the claypanlike upper subsoil layer restricts under-drainage. The porous friable topsoil, however, is sufficiently thick in most places to absorb and store the moderate moisture of average years, and this soil as a whole has less excess moisture than the associated Fillmore soils. Many areas are suited to crop production, but owing to their small size are included in pastures. In other counties, where the soil occupies large areas, it is important agriculturally and during average years equals or exceeds Crete silt loam in productiveness. In wet seasons, however, the topsoil becomes too moist and in dry years too dry for maximum crop yields. The soil therefore is considered slightly inferior to Crete silt loam for general-farming purposes.

#### NUCKOLLS LOAM

Nuckolls loam is very similar to Hastings silt loam except that the subsoil has a pronounced reddish cast. The surface layer consists of very dark grayish-brown loose mulchlike silt loam or very fine sandy loam from one-fourth to about 1 inch in thickness. The next layer, which continues to a depth of about 10 inches, is similar in color but breaks naturally into more or less rounded granules about one-eighth inch in diameter. A laminated or platy structure, though faintly developed in some places in the upper 2 or 3 inches of the layer, does not seem so characteristic of this soil as of the Hastings soils. This layer is composed of loose mellow silt loam containing considerable very fine sand and fine sand and an abundance of organic matter, which has thoroughly permeated the structure particles. The layer contains scattered well-rounded worm casts about one-sixteenth inch in diameter, which in a few places occur in groups or clusters still retaining parts of their cystlike envelopments. The third layer, which extends to a depth of about 21 inches, is similar to the one above except that it is a trifle more compact and that the organic matter occurs more as a film or coating on the surface of the structure particles.

The next, or fourth, layer is light reddish-brown heavy silt loam which continues to a depth of about 3 feet. It has evidently received some clay from the overlying layers and is the horizon of maximum compaction. The material remains very friable, however, except when extremely dry, and there is no suggestion of a claypan. This layer contains numerous old insect and worm holes, which have been filled with darker material from the overlying layers, giving the horizon a rather mottled appearance. The last or fifth layer is the one of maximum lime accumulation. It consists of friable silt with faintly developed columnar breakage. The columns are of various lengths but average about 4 inches in diameter. Basically this layer is light reddish brown as is the overlying layer, but the material

contains much white lime in the form of soft and hard concretions, large and small filmlike splotches, and narrow tortuous seams. This layer lies between depths of 3 and 5 feet and is underlain by the parent material, pale reddish-brown or grayish-brown columnar silt with a faint reddish tinge and known by State geologists as red loess or the Loveland phase of the loess. It contains lime to a depth below 12 feet, but the carbonates seem to be more uniformly distributed and slightly less abundant than in the layer above.

A few variations from typical occur throughout areas of Nuckolls loam in Franklin County. The surface soil is much deeper on the more level areas, whereas on the steeper slopes it has been greatly thinned and in a few places entirely removed by erosion, thus exposing the reddish-brown upper subsoil layer. Even on moderate slopes local patches have a decidedly reddish cast in the surface soil and in many places the soil was identified by this characteristic alone. In a few places the topsoil and subsoil contain considerable fine and medium sand.

Nuckolls loam occurs only in small scattered areas and strips on the upland slopes, chiefly in the eastern part of the county. One of the largest is a narrow strip along one of the branches of Thompson Creek in Buffalo Township. Smaller tracts lie along the numerous tributaries of this stream and within the drainage system of Little Blue River west of Campbell. Very few areas occur south of Republican River. Tracts range from strongly undulating to steeply rolling, but by far the greater part of the soil is on comparatively steep hillsides and is in general unsuited to cultivation. Drainage over most of the areas is excessive, and erosion is severe.

About 95 per cent of this soil remains with its native covering of grasses, including the same species as occur on the Holdrege and Hastings soils. It is used for pasture land. The more gently sloping areas are well suited to all crops common to the region, and yields are about the same as on the Holdrege soils.

As this soil ordinarily occupies only a small part of the farms on which it occurs, it is usually sold in connection with other soils. The more eroded areas detract somewhat from the general value of the farm.

#### DERBY SANDY LOAM

The surface layer of Derby sandy loam is dark grayish-brown loose structureless sandy loam from 5 to 8 inches deep. It contains sufficient silt, clay, and organic matter to insure stability even when the sod is broken. The organic matter, however, is less abundant than in the Holdrege soils, as is indicated by the lighter color. The second layer, which continues to a depth of about 12 inches, is similar in color to the layer above but has a faint reddish tinge. It has an imperfectly developed columnar breakage and consists of structureless loamy sand with even greater coherence than the surface layer. In its natural moist condition the material is friable, but it becomes moderately hard and brittle on drying. An air-dried lump, however, can be easily crushed into loose incoherent loamy sand between the thumb and fingers. Between depths of 12 and 20 inches, the material is pale reddish brown and the organic-matter content is very slight. The consistence and breakage are apparently similar to those in the overlying layer, but the material when dry crushes to

pale reddish-brown almost pure fine sand. The remainder of the soil to a depth exceeding 6 feet is reddish-brown loose incoherent fine or medium sand with no apparent breakage. It is the material from which the soil has weathered and closely resembles that underlying the members of the Valentine series except in its reddish color. This soil is very low in lime throughout and no part of it effervesces with hydrochloric acid. Organic matter, although moderately abundant in the surface layers, decreases rapidly with depth and only faint traces occur below a depth of 14 inches. The soil has weathered from pale reddish-brown sand which seems to underlie some of the loessial material in this part of Nebraska.

Derby sandy loam occurs in numerous small areas and narrow strips on the slopes and lower divides in that part of the loess hills division of the county north of Republican River, mostly in Grant, Buffalo, and Marion Townships. The largest areas are along Thompson Creek and its tributaries. Areas are steeply sloping or hilly and occur mainly on narrow well-rounded ridges or hilltops and steep slopes from which the gray loam covering has been removed by surface wash. Both surface drainage and underdrainage are excessive. The soil is subject to severe erosion, has low water-retaining power, and is very droughty.

Derby sandy loam is of little agricultural importance in Franklin County. Its unfavorable relief and droughtiness render it unsuited to crop production, and practically all of it is included in pasture land. The native vegetation consists of a fairly luxuriant growth of sand grass, stipa or needle grass, and bluestem. From 4 to 6 acres of the land are required to support a cow or horse during the summer grazing season.

As most areas of this soil occupy only a small part of the farm on which they occur, the land is sold in connection with better farming soils.

#### BRIDGEPORT VERY FINE SANDY LOAM

Bridgeport very fine sandy loam consists of grayish-brown loose structureless very fine sandy loam more than 4 or 5 feet deep. The material has not weathered sufficiently to have developed layers or zones, but the surface 10 or 12 inches contains a little more organic matter and is slightly darker than the remainder of the soil. The soil is highly calcareous, effervescing freely with hydrochloric acid. The lime occurs in disseminated form, and there are no spots of unusual carbonate accumulation. This soil has developed over a rather uniform mixture of fine sands and silt deposited near the base of the upland slopes, partly as colluvial material and partly as sediments left by the streams when they were flowing at higher levels. It may vary in texture within narrow limits but is otherwise remarkably uniform in Franklin County.

Soil of this kind occurs in only a few isolated areas and narrow strips within the valleys of Turkey Creek, Thompson Creek, and Republican River, where it occupies colluvial slopes and gently sloping terraces. The largest area forms a narrow strip along one of the tributaries to Turkey Creek in Ash Grove and Farmers Townships. Another tract is along West Branch Thompson Creek near its mouth. Areas are flat or very gently undulating. The slope is

sufficient to carry off surplus surface moisture, and the porous subsoil affords ample underdrainage. The soil is fairly retentive of moisture.

On account of its small extent Bridgeport very fine sandy loam is of little agricultural importance in Franklin County. It is a good farming soil, however, and practically all of it is under cultivation, chiefly to corn and alfalfa. Crop yields are about the same as on Holdrege silt loam and Holdrege very fine sandy loam. This soil is neither so strong nor so fertile as the Holdrege soils, but its lower position and more favorable moisture supply tend to make it very productive.

#### BRIDGEPORT LOAMY FINE SAND

Bridgeport loamy fine sand is incoherent light grayish-brown fine or medium sand to a depth below 4 feet. The 6-inch surface layer contains some organic matter which gives it a more loamy texture and slightly darker color than the remainder of the soil, but the organic content is nowhere sufficient to insure stability, and the soil drifts more or less during dry windy weather. Lime carbonate is abundant below a depth of 18 or 20 inches. It occurs in finely divided form thoroughly mixed with the sands, and no layers of unusual carbonate accumulation exist. This soil differs from Valentine sand only in the higher lime content of its subsoil.

The soil occupies sandy slopes and sloping terraces along streams. It has been deposited over coarse materials which have been carried to their present position by colluvial, wind, and water action from the adjoining uplands.

This soil occurs in only a few small areas, chiefly in the west-central part of the county. The largest areas are along some of the tributaries to Turkey Creek. The land is flat or very gently undulating, except where locally modified by wind action which has produced a rather hummocky relief. Owing to the looseness and porosity of the sands, drainage is good and in most places is excessive. The soil has low moisture-retaining powers and is very droughty.

Bridgeport loamy fine sand is of little agricultural importance on account of its small extent, incoherence, and droughtiness. It is all included in pasture land. The growth of native grasses is rather sparse. Consequently the soil is not valued highly, even for grazing purposes.

#### VALENTINE SAND

Valentine sand consists of loose incoherent fine or medium sand to a depth ranging from 8 to 10 or more feet. The surface 4 or 5 inches, owing to a slight organic-matter content, is in most places a little darker than the remainder of the soil. The soil drifts badly when the protective vegetation is removed. Below a depth of 5 inches the soil material is practically devoid of organic matter and does not differ noticeably from the almost pure sand underlying dune-sand areas. The sand, which includes medium, fine, and very fine grades, the medium sand predominating, is chiefly quartz and feldspar. This soil is very low in lime.

The color, depth, and organic-matter content of the surface soil differ somewhat depending on the relief. This layer is deeper and darker in the lower and more protected situations where conditions have been most favorable for the growth and decay of plant life.

Locally it contains so much organic matter as to become loamy sand in texture. On the crests of low rounded knolls and ridges, however, the organic matter has been largely removed by the wind, leaving the surface soil shallow and prevailingly light in color. In many places around the margins of areas bordering areas of Colby soils, the lower part of the subsoil is lighter colored and finer-textured than typical, being yellowish gray or almost white fine sandy loam or very fine sandy loam.

This soil has developed only where the upland streams have cut through the loessial mantle, exposing the underlying gray sand sheet. It occurs mainly in the territory drained by Thompson Creek, but small isolated patches lie along Center Creek and on one of the tributaries leading into Turkey Creek. Areas range from flat to gently rolling and are characterized by low rounded hummocks and ridges such as are produced by wind in areas of loose sand. Even the flatter areas are modified in most places by low rounded elevations. Drainage is thorough throughout. There is no surface run-off, but the porous sands absorb and carry off the moisture as fast as it accumulates.

Land of this kind is of little value for crop production on account of its low organic-matter content, low water-retaining capacity, and the danger of soil drifting when the native sod is destroyed. Probably not more than 20 per cent of it is under cultivation. Some corn, cane, and kafir are grown in the lower depressions where moisture conditions are most favorable. Small grain is seldom grown on account of the looseness of the seed bed. Yields of all crops are usually low, except in the most favorable seasons. Most of the land remains with its original covering of grasses and is used for cattle grazing and hay production. The native vegetation consists of sand grass, stipa, big and little bluestem, and a little grama grass. These grasses support from 150 to 250 head of cattle to the square mile during the summer grazing season, or when cut for hay yield about one-half ton to the acre.

#### BLOOMINGTON SILT LOAM

The surface layer of Bloomington silt loam, to an average depth of 5 inches, is dark grayish-brown friable silt loam having a moderately well-developed very finely granular structure. Few of the individual aggregates exceed one-eighth inch in diameter. The material in places is covered by a structureless silt loam mulch less than one-half inch thick. In places the lower part of the layer is faintly laminated, but laminated or platy material is not so well developed as in the topsoils of the Holdrege, Hastings, or Hall soils. Organic matter is moderately abundant and thoroughly disseminated throughout the soil mass. The next layer, which lies between depths of 5 and about 15 inches, is similar in texture. The granulation, however, is more perfectly developed and a lump when dropped or pressed lightly breaks into a loose granular mass in which the individual aggregates are well rounded and from one-eighth to one-fourth inch in diameter. The granules are slightly lighter in color than those of the surface layer and have a faint reddish cast. The peripheries of the granules are somewhat darker than the interiors, probably indicating that the organic matter has not permeated the soil aggregates so deeply as in the layer above.

The third layer, occurring between depths of 15 and about 25 inches, is slightly compact heavy silt loam or silty clay loam which breaks naturally into small subangular lumps from one-fourth to about three-fourths inch in diameter. The lumps have a reddish cast similar to those in the layer above, but the material averages slightly lighter in color, owing to a thinning of the organic film on the surface of the structure particles. This layer is the one of maximum compaction, but the material remains friable, and there is no suggestion of a claypan. Between depths of 25 inches and about 3 feet the soil material has no definite structure. It is friable reddish-brown silt loam which breaks into angular clods of various sizes and shapes and contains numerous twisted rodlike intrusions, probably old filled-in worm or insect cavities, about one-fourth inch in diameter. The rodlike forms may be lighter or darker in color than the main soil mass, depending on whether the filling material was derived from the overlying or underlying layers. Below a depth of 3 feet are small angular fragments of limestone which become more numerous with depth. The parent chalk rock or sandstone formations from which the soil has weathered occur at a depth of about 4 feet.

This is a residual soil, which weathered in its present position from the bedrock of the region. Wash from the higher-lying loessial soils has in many places modified the surface layers.

Bloomington silt loam lacks uniformity in Franklin County, differing greatly both in the thickness and color of the surface layers and in the depth to underlying bedrock. In the rougher areas the surface layers have lost much of their organic matter and have been greatly thinned by erosion. In many places the rapidity of the run-off has resulted in the removal of the entire weathered soil material and the exposure of small patches of underlying bedrock. In general, however, the weathered soil material extends to a depth of at least 2 feet.

Bloomington silt loam occurs in rather large areas in Franklin and Washington Townships in the southeastern part of the county, and in small areas in Oak Grove and Turkey Creek Townships in the southwestern part. The only tract north of Republican River lies northwest of Riverton. The land occupies gradual or steep slopes and broad or narrow divides lying below or near the base of the old loessial mantle which once covered the entire region. Most of the broader divides are very rolling. Drainage is everywhere thorough, and on the steeper slopes run-off is excessive and erosion severe.

Bloomington silt loam is probably the most important agricultural soil south of Republican River. It is not so extensive as Colby silt loam but its relief is a little more favorable to cultivation, and a much larger proportion is used for crop production. Only about 10 per cent, including the rougher and more severely eroded areas, remains with its native covering of grasses, similar to those on the Holdrege soils. By far the greater part of the land is used in the production of corn, wheat, alfalfa, and oats, ranking in acreage in the order named. Cattle are grazed in the rougher sections, but the cattle industry consists largely of the winter fattening of beef animals.

Crop yields range widely, depending on the rainfall. On account of the slightly lower organic-matter content of this soil they usually average a trifle lower than those obtained on the Holdrege soils but are about equal to those obtained on the less eroded areas of Colby silt loam.

#### SOGN SILT LOAM

Sogn silt loam consists of loose friable silt loam 5 or 6 inches thick, which rests directly on light-colored limy bedrock. The thin soil covering has been leached of most of its organic matter and in most places is light grayish brown. Over much of the soil erosion has removed the weathered soil material as fast as it has formed, and there are numerous outcrops of the white bedrock, which consists almost entirely of Niobrara chalk rock, a soft chalky limestone of Cretaceous age which contains very little sand. In a few places, however, a thin layer of Tertiary material, consisting of light-gray or white loosely indurated and very limy sandstone, overlies the chalk rock formation. The soil has developed under conditions unfavorable for soil weathering.

Sogn silt loam occupies steep slopes and sharp divides in the uplands south of Republican River. It occurs chiefly in Franklin and Washington Townships, but small areas are as far west as central Turkey Creek Township. Areas, though steeply sloping and severely eroded, are not so rough and gullied as areas of rough stony land. Precipitous slopes or high vertical rock exposures are few, and the land does not present a harsh angular appearance.

This soil supports a fair growth of grama, buffalo, and bluestem grasses except on the exposures of bedrock. It is used exclusively for grazing land. The grasses support from 80 to 100 head of cattle to the section during the summer grazing season.

Land of this kind is usually sold in connection with areas suitable for farming. It reduces the sale value of the farm on which it occurs.

#### SOGN GRAVELLY LOAM

To a depth ranging from 4 to 30 inches Sogn gravelly loam consists of a grayish-brown heterogeneous mass of sand, gravel, and angular chalk rock fragments. The interstitial spaces are filled with grayish-brown friable loam or silt loam which tends to give the mass considerable coherence. The material rests on Niobrara chalk rock. It is in reality not a soil but is classed as a Sogn soil owing to its close association with the chalk rock from which the Sogn soils have developed in Franklin County. The origin of the gravel is unknown. It probably represents exceptionally gravelly strata or pockets in the Tertiary formations which gradually settled as the less resistant materials were removed. The limy fragments and the finer-textured materials which comprise the remainder of the mass were probably derived largely through weathering from the parent chalk rock, although some of the silt and clay may have accumulated through wind action. The growth and decay of a sparse grassy vegetation has produced sufficient organic matter to give the surface soil, to a depth of a few inches, a slightly darker color than the remainder of the mass.

Sogn gravelly loam occurs only in small scattered tracts, chiefly in Turkey Creek and Oak Grove Townships, and in a few patches north of Republican River in Grant Township. Areas range from steeply sloping to hilly. Most of the soil occurs on well-rounded hilltops and extends part way down the surrounding slopes. Some of the tracts, however, occur only on the steeper slopes leading to drainage ways. The relief favors rapid surface run-off, but owing to its high gravel content the material does not erode severely.

All this soil is included in pasture land. Most of the individual tracts occupy only a small part of the farm on which they occur and are sold in connection with good farm land. They tend to decrease the value of the farm.

#### LAMOURE SILT LOAM

The surface layer of Lamoure silt loam is very dark grayish-brown heavy silt loam from 8 to 12 inches deep. It is loose and friable in its naturally moist condition but becomes moderately hard and brittle on drying. The next layer, which extends to an average depth of 18 inches, is slightly darker and a little more compact than the one above, owing to its higher organic-matter and clay content. The third layer, lying between depths of 18 and about 30 inches, is similar in color to the surface layer but contains more clay than either of the overlying layers and consists of very dark grayish-brown moderately compact silty clay loam which is plastic and sticky when moist but becomes hard and brittle when dry. This layer is underlain by light grayish-brown stiff waxy silty clay which continues to a depth of about 50 inches, at which depth it rests on coarse-textured sand or gravel. The entire soil is more or less finely granular and has a high lime content. It closely resembles Wabash silt loam occurring in eastern Nebraska, except in its higher lime content and the lighter color of its lower subsoil layer.

Lamoure silt loam occurs chiefly in several small patches in the Republican River bottoms. Several areas lie within the flood plains of Turkey and Thompson Creeks. The largest area, including about 160 acres, is southwest of Riverton on the south side of Republican River. A smaller though very typical area lies east of Reams School in Washington Township. The land is flat and almost level except where modified by shallow depressions, old cut-offs, and stream channels. Drainage is poor in most places. The areas lie only a few feet above normal stream level and are subject to occasional inundation during periods of high water. Even during seasons of normal precipitation the underlying water table is rather near the surface and the subsoil remains constantly wet.

Practically all this soil is included in pasture and hay land. It is very strong and fertile, however, and when adequately drained will produce exceptionally high yields of corn and alfalfa. The native vegetation consists of a luxuriant growth of water-loving grasses and sedges which support a cow or horse on each acre during the summer grazing season or when cut for hay yield about 1 ton to the acre.

## DUNE SAND

Dune sand consists of gray or grayish-brown fine or medium incoherent sand which has been but little modified by weathering. This material extends to a depth ranging from 8 to 10 or more feet with little change in texture. The surface layer, to a depth of a few inches, contains some organic matter but not enough to prevent drifting when the covering of grasses is removed. The material is fairly retentive of moisture, considering its looseness and porosity. It is very low in lime. There is little variation in areas of dune sand in Franklin County, except locally where a little more silt, clay, and organic matter, owing probably to more favorable weather conditions and the growth and decay of plant life, have given the material a somewhat more loamy texture than typical. These loamier areas have a thicker grass covering than most of the material and therefore a greater grazing value.

Dune sand occurs only in a few small tracts along Thompson Creek. It is similar to and has accumulated in the same manner as Valentine sand but differs from that soil in its more uneven surface relief, the sand being piled into dunes from 20 to 30 feet high. Dune sand contains less organic matter, is less stable, and is less desirable for grazing than Valentine sand. Very little of this material, however, is now subject to active wind erosion. No continuous waterways pass through areas of dune sand, but the rainfall is rapidly absorbed by the loose porous sands and there is practically no run-off.

Dune sand is of no value for cultivated crops, as destruction of the native sod is followed by damaging wind erosion. Practically all the material is included in pasture land. The native vegetation includes a great number of grasses, of which long-leaved reed grass, redfieldia, stipa, and bluestem are the most common. These grasses maintain a cow or horse on each 5 or 6 acres during the summer grazing season.

## ROUGH STONY LAND

Rough stony land includes those parts of the county in which rock outcrops are most numerous, and the surface is extremely rough and broken. This class of land is mapped chiefly in areas in which Tertiary sandstone is exposed or lies very near the surface of the ground. Rock cliffs and steep rocky exposures of the sandstone are a characteristic feature. In the more protected situations 4 or 5 inches of light grayish-brown silt loam or sandy loam remains, but the relief even in such areas precludes the use of the land for crop production. Rough stony land differs from Sogn silt loam in its greater relief and rougher and more angular topography and in the character of the underlying bedrock. The Sogn soils have developed principally on Cretaceous chalk rock, whereas rough stony land has developed mainly over Tertiary sandstones. In a few places considerable coarse sand and gravel is scattered over the surface.

Included with mapped areas of rough stony land are some gravelly areas in which an incoherent mass of sand and gravel extends to a depth of 2 or 3 feet. Such areas occur principally north of Republican River.

Rough stony land occupies a few small bodies north and south of Republican River in the south-central and east-central parts of the

county. One of the largest areas, comprising about 100 acres, includes Lookout Mountain in Franklin Township. Another area of similar size is about 1 mile northeast of Sunny Hill School. Most of the remaining bodies, which are few and small, occur along Reams and Calumet Creeks. The land supports a fair growth of the prairie grasses common to the region and is all used for grazing purposes.

Rough stony land includes only a small part of the farms on which it occurs and is sold in connection with soil adapted to crop production.

#### RIVER WASH

River wash includes the lowest-lying alluvial deposits in Franklin County. It consists of islands, bars, and strips of sand within or bordering the channels of Republican River and a few of its tributaries. The material is not extensive, as the individual bodies are few and small. One of the largest areas occurs as a narrow strip along Center Creek in Macon and Bloomington Townships. The surface lies but a few feet above the normal flow of the streams, and the land is subject to frequent inundation.

River wash is not permanent, the material changing with each stream overflow and even during normal flow being shifted about, added to, or destroyed by the changing current. It is also modified to some extent by the wind. River wash supports a scant growth of grasses and willows and is all included in pasture land. The more stable tracts are undergoing changes from weathering and will ultimately develop into soils similar to other bottom-land soils.

#### AGRICULTURE

Prior to 1870 the area now included in Franklin County was inhabited chiefly by Indians although there were a few cattlemen, hunters, and trappers in the region. The first people to use the land for agriculture were members of a colony from Omaha, Nebr. They located on the north side of Republican River near the present town of Riverton. Several colonies were organized within the next few months within the Republican Valley. Later, settlement rapidly spread throughout the uplands. The first sod was broken for crops in 1871. Sod corn, potatoes, a few vegetables, and game formed the chief food of the early settlers. As settlement increased and conditions became more stable, wheat, oats, rye, barley, and vegetables were grown. Ranching was followed to some extent but became important only in the rougher or more sandy sections. Over most of the county larger returns were obtained from grain crops.

The early development of agriculture was slow, owing to the lack of markets and transportation facilities and to the ravages of insect pests. Grasshoppers did considerable damage in 1874. The construction of the Chicago, Burlington & Quincy Railroad to Bloomington in 1879 gave the first marked impetus to agricultural progress.

The census reports the average value of all farm property to the farm, including land, buildings, implements, and domestic animals, to be \$1,266 in 1880, \$3,560 in 1890, \$5,013 in 1900, \$13,389 in 1910,

and \$21,688 in 1920. Between 1880 and 1920 the number of farms in the county had increased from 1,132 to 1,394.

Table 5, compiled from the census reports, gives the acreage and production of the principal crops of the county in 1879, 1889, 1899, 1909, 1919, and 1924 and shows the general trend of agriculture during the last 45 years.

TABLE 5.—Acreage and yield of principal crops in stated years

Crop	1879		1889		1899		1909		1919		1924	
	<i>Acres</i>	<i>Bush.</i>	<i>Acres</i>	<i>Bush.</i>	<i>Acres</i>	<i>Bush.</i>	<i>Acres</i>	<i>Bush.</i>	<i>Acres</i>	<i>Bush.</i>	<i>Acres</i>	<i>Bush.</i>
Corn.....	17,913	511,347	50,918	2,007,650	91,945	2,120,950	91,702	1,497,937	84,823	2,027,067	95,829	1,900,980
Oats.....	1,481	30,766	11,834	333,728	17,192	405,280	14,139	358,241	8,623	248,377	9,015	178,731
Wheat.....	15,780	136,272	18,424	232,504	29,849	310,290	45,288	633,625	63,093	990,214	40,353	698,952
Potatoes.....		21,176	931	85,642	823	73,040	705	47,002	648	22,091	448	37,161
Hay.....	4,986	<i>Tons</i> 6,529	17,676	<i>Tons</i> 22,999		<i>Tons</i>		<i>Tons</i>		<i>Tons</i>		<i>Tons</i>
Tame.....					5,110	13,283	15,355	24,486	12,145	19,497		29,029
Wild.....					18,886	17,614	20,696	18,056	16,945	14,010		23,113
Coarse forage.....					1,371	4,808	1,526	3,576	8,021	18,255		

<sup>1</sup> Principally alfalfa.

As throughout eastern and southern Nebraska, grain growing in connection with the livestock industry is the principal agricultural occupation followed in Franklin County. Considerable attention is given to the winter fattening of cattle, the raising of hogs, and the production of dairy and poultry products. Corn, oats, wheat, alfalfa, and wild hay are the leading crops.

The type of farming practiced is uniform throughout the county, but the comparative importance of the various crops differs with the locality. The proportion of land used for grazing or hay production is larger throughout the poorly-drained parts of the bottom lands and the rougher or more sandy uplands than elsewhere. A larger proportion of the better-drained terrace lands is used for alfalfa on account of the more favorable moisture supply and usually higher yield.

According to the Federal census, the value of all crops produced in Franklin County in 1919 was \$5,985,085. Dairy products were produced to the value of \$272,870 and poultry and eggs to the value of \$333,346. The total value of all domestic animals on farms in the county in January, 1920, was \$2,668,519.

Corn is the leading crop and the chief cash crop on farms where it is not fed to livestock. The Nebraska agricultural statistics report 110,094 acres in corn, with a production of 1,321,128 bushels, or an average of 12 bushels to the acre, in 1925. Much higher yields, however, are obtained throughout the alluvial lands and on the Hastings and Holdrege soils of the uplands, where from 25 to 40 bushels to the acre are commonly produced. On farms operated by owners, most of the corn is fed to hogs, beef cattle, and work animals, but on tenant farms a considerable proportion is sold. On farms with silos corn from 15 or 20 acres is cut each year for silage. Most of the corn is husked in the fall and cattle and horses are pastured on the stalks during the winter. Many farmers fence off a few acres of unhusked corn for hog range and a few husk only

enough to supply their work animals, allowing cattle to feed in the fields until fattened. Some corn is cut for fodder. Many tenant farmers grow corn on the same land for several consecutive years, but better yields are obtained when this crop is grown in rotation with small grain and alfalfa. Seed selection is not generally practiced. Practically all the corn is of the dent varieties, though the strains are seldom kept pure. White corn is grown chiefly, and Iowa Silvermine is probably the leading variety. Corn is grown on all soils of the county except the poorly-drained flood plains, the rougher sections of the uplands, and the more sandy Valentine soils. The well-drained bottom lands and terraces and the less eroded upland areas are preferred.

Wheat, practically all winter wheat, ranks second in acreage among the grain crops. Yields of winter wheat fluctuate less and there is less danger of smut and rust than with spring wheat. Winter wheat can also be planted in the fall after the busy season is over, and it matures earlier than spring wheat, thereby avoiding much of the dry windy weather of late summer. The Nebraska agricultural statistics for 1925 report 31,792 acres in wheat with an average yield of 9 bushels to the acre. Turkey and Kanred are the leading varieties of winter wheat. The varieties are kept pure by the more progressive farmers, but on many tenant farms they have been mixed.

Oats rank next to wheat in acreage. In 1925 the acreage was 16,268 acres, yielding 325,360 bushels, an average of 20 bushels to the acre. This crop is grown on all the improved soils of the county, but is poorly suited to the more sandy soils on account of its shallow root system and the danger of injury to the young plants by drifting sand. It is less profitable than corn or wheat, but is very important as feed for work animals and in crop rotation. Oats are usually planted as the intervening crop between corn or alfalfa and winter wheat. Kherson and Swedish Select are the leading varieties. The oat crop does well on the heavier-textured upland and terrace soils, but on the bottom lands it grows too rank and often lodges. The Kherson variety, having a short stiff straw, has given the best results on the flood plains. A few farmers import seed from other sections, but the usual method is to clean a sufficient amount of the previous crop for seed for the next season. Very little oats is sold. The straw has a higher feeding value than that of most small-grain crops and is fed to horses and cattle.

Rye is grown to a small extent, generally for the grain but to some extent for hay and pasture. It usually yields better than wheat and thrives on poorer soil. Its low market value, however, has tended to curtail its production. Most of the rye is fed to hogs on the farms. Barley is used on a few farms for hog feed. This crop thrives on the terrace and bottom-land soils, where the highest yields are obtained, but does not seem to do well on the uplands, probably on account of an insufficient moisture supply.

Of the hay crops, wild hay occupies the largest acreage. Alfalfa is the leading tame hay. It is grown on all the heavier-textured soils of the county. The highest yields are obtained on the better-drained parts of the bottom land where more favorable moisture conditions prevail. The alfalfa crop is usually cut three times each season. It is fed to cattle and hogs but seldom to work horses, as the dust in the

hay irritates the breathing organs and has a tendency to produce heaves. Many farmers run hogs in the field during the summer, but cattle are seldom allowed to graze on green alfalfa on account of the danger of bloating. Alfalfa has a high nutritive value, yields well, and is very valuable in increasing the productiveness of the soils for grain crops.

Among the minor crops millet, sorghum, kafir, clover, and timothy are grown by many farmers for feed, and potatoes for home consumption. Watermelons and cantaloupes are grown in a small way on the more sandy bottom-land and terrace soils. Many farmers have small orchards of fruits of different kinds, and a few large apple orchards were seen. On most farms, however, the trees are in poor condition as little attention is given to pruning and spraying. The local demand for fruit is not supplied, and it would seem that fruit growing could be profitably extended. Apples, cherries, plums, peaches, and pears are the most important cultivated tree fruits. Wild plums and grapes are abundant along the larger streams during favorable seasons.

The livestock industry holds an important place in the agriculture of Franklin County. The raising and winter fattening of cattle is the most important branch of this industry. According to the census there were 24,314 cattle in the county in 1925. About three-fourths were beef cattle. Most of the herds are of grade stock headed by a purebred bull, and the quality of the animals is in general very good. The principal breeds are Hereford and Shorthorn, although Aberdeen-Angus cattle are increasing in popularity. Most of the cattle are raised locally, but a few farmers ship in cattle for summer grazing and many feeders annually purchase animals for winter fattening. The animals are fed corn and alfalfa from 60 to 90 days and are then shipped to the Omaha or Kansas City markets.

Dairying receives little attention. A few purebred dairy herds are maintained, but no farms are devoted exclusively to dairying. Holstein is the leading breed of dairy cattle. Nearly every farmer in the county milks a few cows, mainly of the beef breeds, and sells the surplus products in local markets.

Hog raising is an important branch of the livestock industry. Nearly every farmer fattens a few hogs for market each year, and many have large herds. Poland China, Hampshire, and Duroc-Jersey are the leading breeds. A few farmers have purebred herds, but most of the animals are grade stock. Hogs are usually fattened on corn, either in feeding yards or in the fields where they are allowed to hog down the corn in the fall. Alfalfa is usually added to the ration, and during the summer months the animals are often allowed to run in the alfalfa fields until the third crop is cut. Hog cholera has been very destructive in the past, but losses from this disease have been largely eliminated during recent years by attention to sanitation and vaccination.

Most farmers raise their own work animals and occasionally have a team to sell. The horses are of heavy draft type, ranging in weight from 1,300 to 1,600 pounds. The stallions are purebred, but most of the mares are grades. A few mules are raised.

A few sheep are raised in the rougher sections of the county, but the sheep industry consists chiefly of the fattening of ewes and lambs imported from the Omaha or Kansas City markets.

Poultry provides an important source of farm income. Chickens are raised on nearly every farm and many farmers have large flocks. The demand for poultry products has been rapidly increasing during recent years, and the poultry industry is receiving considerable attention. Leghorn, Plymouth Rock, and Rhode Island Red are the leading breeds. Some ducks, geese, turkeys, and guinea fowls are raised.

Variations in yields on different soils and the suitability of certain soils to particular crops are observed to some extent by the farmers. They recognize that alfalfa does not thrive on the sandy Valentine soils, that corn yields better on the Holdrege than on the Colby soils, that small grain does better on fine-textured soils than on the sandy ones, and that the highest yields of all cultivated crops are obtained on the better-drained bottom lands and terraces. Although these crop adaptations are generally recognized there is not sufficient variation in yields to cause specialized farming in any part of the county, except on those areas which are suited only for grazing or hay production because of their rough topography, poor drainage, or sandy texture.

Systematic crop rotation is not generally practiced. Considerable alfalfa is grown, however, and tends in a small way to maintain the fertility of the land. A few progressive farmers have evolved more or less indefinite systems of crop rotation, but the price of and demand for farm products are the controlling elements in the rotation system. Corn or wheat is grown on the same land several consecutive years by many farmers. A rotation which seems to have merit consists of 2 years of corn, 1 year of oats, rye, or barley, 1 or 2 years of wheat, and from 4 to 6 years of alfalfa.

The farms in Franklin County are well improved. The buildings are ample for all farm needs and are usually painted and kept in good repair. The farms are fenced and cross fenced, mostly with barbed wire although a few farms are inclosed with hog-tight woven-wire fencing. The Nebraska agricultural statistics report 99 gasoline tractors in the county in 1925, but dependence for motive power is mainly on horses and mules. The tractors are used on the more level lands. Modern labor-saving implements are in general use, most farms being equipped with manure spreaders, grain drills, mowers, rakes, binders, riding cultivators, gang plows, and disk harrows. A few farmers have corn shuckers, corn binders, and hay balers. Only the more expensive machinery is sheltered.

Commercial fertilizer is not used. Barnyard manure is applied to the land, but the supply is seldom sufficient for best results. On tenant farms most of the manure is distributed on land nearest the barn or feed lots.

Farm laborers are scarce. Wages range from \$30 to \$35 a month with board and room. Day laborers receive from \$3 to \$3.50, and harvest hands were paid as high as \$4.50 during the last season (1926). Corn shuckers receive 5 or 6 cents a bushel. Oats are threshed for 6 cents and wheat for 4 or 5 cents a bushel. A few farmers hire help by the year in order to insure against lack of labor at critical periods.

According to the census the percentage of land in farms increased from 52 per cent in 1880 to 92.6 per cent in 1920. The average size of the farms in 1920 was 245.8 acres, and the proportion of farm land

improved was 67.3 per cent. The farms range greatly in size, but most of them include between 100 and 500 acres.

The proportion of farms operated by owners has decreased from 85.9 per cent in 1880 to 55.9 per cent in 1925. Both cash and share systems of rental are in vogue, and sometimes a combination of the two is used. Under the share system, which is most popular, the owner receives two-fifths of the grain, delivered, and about \$3 an acre for pasture land. All seed, labor, and machinery are furnished by the tenant. When alfalfa land is rented on shares the owner receives one-half the hay stacked in the field. Under the cash system the tenant pays \$4 or \$5 an acre for the use of the farm land and \$3 an acre for the pasture land. Many farms suited only for pasture are rented for a lump sum, the price depending on the carrying capacity of the range. On a few farms the renter is allowed the use of the pasture land without charge. Since the World War very little land which is suited for grain production has been rented for cash.

The current selling price of farms ranges from \$20 to \$125 an acre, depending on the topography, drainage, character of the soil, and location with respect to markets. The 1920 census reports the average assessed value of farm land in Franklin County as \$67.10 an acre. The lowest-priced land includes the more severely eroded uplands and the small areas of dune sand which are suited only for pasture. The average price of land on the nearly level loess plains is about \$100 an acre. The heavier-textured terrace soils command from \$100 to \$125 an acre, depending chiefly on location. Bottom land along Republican River and its larger tributaries brings from \$50 to \$100 an acre, depending on drainage.

#### SOILS AND THEIR INTERPRETATION

The soils of Franklin County have developed in a climate and under a vegetation favorable for the accumulation of much organic matter in the topsoils and of lime in the lower part of the subsoils. The county is in the prairie region of the United States, and the annual decay of the luxuriant grassy vegetation is the source of the black carbonaceous material or organic matter in the topsoils. This black material has naturally given the upper soil layers a very dark color.

Precipitation in the region has not been sufficient to leach the easily soluble lime from the soil as in regions farther east but has removed it to the lower limits of moisture penetration where it has accumulated, forming a layer of higher lime content than occurs in any other part of the soil. This layer is commonly known as the lime zone. The amount of lime and organic matter differs somewhat in different soils. It is controlled largely by the topography, the character of the parent soil materials, and the length of time these materials have been subjected to weathering. Where there has been a minimum of erosion and the soils have lain undisturbed for the longest time, as on the smoother and more nearly level parts of the uplands and older terraces, the soil-forming processes, including leaching, oxidation, aeration, and the accumulation of decayed vegetable material, have acted to their full capacity. The soils, therefore, have accumulated as much organic matter in their topsoils and lime in their subsoils as is possible under the existing climate and vegetation.

In addition to accumulations of organic matter and lime, the well-developed soils of Franklin County have a more or less finely granular structure in their topsoils and a more coarsely granular or cloddy structure in their subsoils. Moreover, the topsoils and subsoils have developed layers or horizons which differ from one another in some important and usually easily discernible feature, such as color, lime content, texture, structure, or compaction.

The characteristics of the topsoils and subsoils have been produced by the fundamental soil-forming processes mentioned. They may also have been influenced somewhat by the character of the materials from which the soils have weathered, but the parent materials are undoubtedly of minor importance in determining the present character of the well-developed soils, however important they may have been in the early stages of soil formation. The slight importance of the parent materials is especially evident, since soils derived from loess, sandstone, limestone, or shale when fully developed are very similar in their major characteristics. Moreover, well-developed soils which have weathered from the same formation show local and in many places pronounced differences in their profiles.

Dark more or less granular topsoils, coarser-textured subsoils with lime accumulations, and layers or horizons in both topsoil and subsoil are indicative of complete soil development and characterize the greater part of the soil in Franklin County. There are, however, numerous areas in which the normal action of the soil-forming processes has been hindered by counteracting forces such as stream or wind erosion, recent age or resistant nature of the parent soil materials, or imperfect drainage. Such areas are in the more sandy parts of the county, in basinlike depressions throughout the uplands, on severely eroded lands, and on the more recent alluvial deposits. Even in these localities, however, the soils have made some progress toward development, the degree depending on the resistance of the counteracting forces. There are, therefore, in Franklin County several kinds of soil which, although differing in detail, may be combined on the basis of similarity in major characteristics into several groups which for convenience but not on account of topographic features will receive the following designations: (1) Well-drained soils developed on smooth relief; (2) imperfectly drained soils developed on flat surfaces; (3) imperfectly developed soils on hilly or rolling surfaces; and (4) alluvial soils.

The well-drained soils developed on smooth relief are the most extensive in the county and include those in which the soil-forming processes have effected their maximum results for the region.

The topsoil consists of three well-defined layers, all of which are dark and very friable. The upper layer is very thin and consists of a loose structureless mulch in few places exceeding 1 inch in thickness. It is dustlike when dry. The second layer is laminated, the soil particles being grouped into thin, horizontal, disklike plates which overlap one another. The laminated layer is from 2 to 5 inches thick. The lower topsoil layer is more or less granular. It is from 12 to 15 inches thick and extends to an average depth of 20 inches. The soil particles are grouped into small rounded or subangular aggregates ranging from one-sixteenth to slightly more than one-fourth inch in diameter. The layer may or may not be columnar.

The three topsoil layers are in most places similar in texture, being composed largely of silt and very fine sand particles. They are rich in organic matter which in the upper two layers is thoroughly mixed with the mineral soil particles, making these layers uniformly very dark grayish brown or almost black. In the third layer the organic matter occurs chiefly as a film or coating on the surface of the granules. The film is thickest in the upper part of the layer, making that part as dark and apparently as rich in organic matter as the overlying horizons. The granular material, however, becomes lighter in color when crushed than similarly treated material from the laminated or structureless layers. This indicates a lower organic-matter content. The organic film decreases in thickness with depth, and the lower part of the granular layer is dark grayish brown or, when crushed, grayish brown.

The fourth or upper subsoil layer is the one of maximum compaction. This horizon is about 12 inches thick and extends to an average depth of 30 inches. The degree of compaction varies considerably, depending on topographic and drainage conditions. The layer has been formed by the translocation of the finer-textured surface particles through the agency of percolating waters and is naturally thicker and more compact in those areas where surface drainage has been rather slow. An extremely compact or claypan-like condition in this horizon, however, does not occur in the smooth well-drained upland and terrace soil group. In most places the layer is friable or only moderately compact silt loam or silty clay loam, ranging in color from grayish brown to dark grayish brown but containing less organic matter per unit of volume than any of the overlying layers. The material has numerous vertical and horizontal seams and cracks and can be broken into more or less cubical clods of various sizes ranging up to 3 or 4 inches in diameter. The clods may be either practically structureless or composed of small, irregularly prismatic-shaped units in which the vertical axes are the longer. Few of the units exceed one-half inch in any dimension. The organic matter of the layer, as in the granular horizon, consists mainly of a mere film or coating on the surfaces of the structure particles.

The fifth layer is transitional in character between the zone of maximum compaction and the lime zone. It is columnar but otherwise structureless silt. The material is grayish brown and faintly compact in the upper part of the layer but becomes rapidly lighter in color and looser with depth, being light grayish-brown flourlike silt in the lower part. It merges with the lime zone at a depth ranging from 4 to 5 feet.

The lime zone or sixth layer consists of very light grayish-brown, light yellowish-brown, or almost white loose floury silt. It has a columnar form but no definite structure, and a lump when dropped breaks into soft angular clods of various sizes and shapes. Lime is abundant, occurring as hard or soft concretions, spots, splotches, fine winding threads, thin fillings in numerous seams and cracks, and in finely divided form thoroughly mixed with the silt. In many places the excessive lime content gives the layer an irregularly mottled gray and white appearance. The thickness of the lime zone is difficult to determine. The top of the layer is sharply defined, and the maximum lime accumulation is confined to the upper 8 to 12 inches.

In the lower part of the layer, however, the lime concretions, specks, and spots gradually become fewer and, since the underlying parent loess usually contains considerable lime, the boundary between the lime zone and loessial formation is very indefinite. As a rule, however, material resembling unweathered loess occurs 6 or 7 feet beneath the surface of the ground, at which depth the loesslike material contains much less lime per unit of volume than does the upper part of the lime zone and shows no evidence of concentration or segregation of the carbonates.

The soils of the smooth well-drained upland and terrace group contain worm casts and twisted rodlike forms of various lengths in all horizons beneath the laminated layer. The casts, however, are usually most abundant in the granular layer, and the rodlike forms occur chiefly in the layer of maximum compaction. The worm casts are more or less spherical and about one-sixteenth inch in diameter. They may be grouped in rounded clusters including from 10 to 25 individuals or may occur as fillings in old root or insect cavities. The rodlike forms, often called borings, are also fillings in root, worm, or insect cavities and may at one time have consisted largely of worm casts, but if so the casts in most places have become obscured and the material comprising them is blended into a uniform mass. The borings are usually lighter or darker than the general color of the layer in which they may occur, depending on whether the material composing them has been derived from overlying or underlying soil layers. In the group characterized by the profile described may be placed the upland soils of the Holdrege and Hastings series and the Hall soils of the well-drained terraces.

The Holdrege and Hall soils in Franklin County are very similar in profile characteristics but are differentiated in soil mapping on account of differences in topographic position. The lower-lying Hall soils are favorably situated to receive moisture and surface wash from the higher-lying lands and are therefore considered slightly superior to the Holdrege for general farming. The Hastings soils are differentiated from those of the Hall and Holdrege series on account of a greater compaction in their upper subsoil layers and a more pronounced granular structure in their lower topsoil layers. The horizon of maximum compaction is transitional in character between the corresponding layers of the Holdrege and Crete soils.

With the smooth well-drained upland and terrace group may also be placed soils of the Bridgeport and Judson series. These soils, however, have been influenced by conditions not common throughout the smooth uplands and terraces as a whole, and their profiles differ considerably from the average. The soils of both series have been developed on colluvial or alluvial materials deposited near the base of gradual upland slopes or on the outer margins of nearly level terraces. The deposits are so recent that sufficient time has not elapsed for the development of soils having definite zones or layers. The soil material is friable, practically structureless, and very uniform in color and texture to a depth below 3 or 4 feet. The deposits from which the Judson soils are derived are very dark grayish brown or almost black, consisting chiefly of surface wash from higher-lying dark soils. The Bridgeport soils have developed on light-colored deposits and are grayish brown or dark grayish brown. The Judson soils are very low in lime and the Bridgeport are calcareous.

The imperfectly drained soils developed on flat surfaces occupy the highest and most nearly level, but not depressed, parts of the loess plains in the northern part of the county and the basinlike depressions throughout the more nearly level uplands. In the level but not depressed areas in the loess plains surface drainage, although adequate, is very slow. The topsoils consist of three layers similar to those in the smooth well-drained soils except that they average slightly darker owing, probably, to more favorable conditions for the retention of organic matter.

The subsoils differ greatly from those of the Holdrege, Hastings, and Hall soils. They are composed of only two layers, the upper of which is a true claypan which has been formed through translocation of the finer topsoil particles by percolating waters and which has developed extreme density. The layer is from 10 to 18 inches thick and consists of olive-brown or dark grayish-brown comparatively impervious clay or silty clay. It is columnar in but few places, and the columns are poorly developed. In most places the dense clay is structureless and breaks into irregular angular lumps of various sizes. However, more or less prismatic-shaped units, few of which exceed one-half inch in any dimension, may occur locally. The lower layer of the subsoil is the lime zone. It is from 15 to 30 inches thick and consists of soft structureless yellowish-gray or almost white silt with scattered rust-brown stains and spots. In many places the upper 4 to 6 inches is more or less transitional and may or may not contain lime. The remainder of the layer is calcareous, but the part having the maximum lime concentration is in few places more than 12 inches thick and either joins the base of the claypan or is separated from it by the transitional material mentioned. The layer of maximum lime accumulation contains numerous concretions, spots, and splotches of white lime which gradually diminish with depth. Disseminated lime continues in decreasing amounts to a depth of 7 or 8 feet.

Beneath the lime zone is loess, the same geologic formation from which the Holdrege, Hastings, and Hall soils have developed. The loess under the flat upland group of soils, however, is seldom noticeably calcareous in the upper 4 or 5 feet. In few places does the claypan or zone of maximum compaction in this soil group contain evidence of worm or insect action. Both worm casts and borings, however, are abundant in the granular layer and may occur locally in the lime zone. The soils of the flat upland group are represented by the Crete series in Franklin County.

In the imperfectly drained soils developed in basinlike depressions throughout the more nearly level uplands surface drainage is not established, and after heavy rains moisture accumulates and is only slowly removed by seepage and evaporation. The basins are alternately wet and dry, being dry during the greater part of each year. The soils, although not constantly inundated during their development, have been subjected to surplus water in larger amounts and for longer periods than those of the Crete series. Downward percolation, therefore, has been more continuous and its results more pronounced. Excessive moisture has favored rank growths of grasses, reeds, and sedges but has not prevailed so continuously as to prevent vegetal decay and the upper soil layers are in most places unusually

dark, almost black. The topsoils are variable in character, owing probably to local differences in drainage.

In few of the deeper basins do the topsoils exceed 6 or 8 inches in thickness. They are very friable, consisting chiefly of laminated silt or silty clay loam. The material is uniform in texture, structure, and consistence, but is extremely variable in color, owing to the presence of various amounts of white flourlike silt which in most places occurs as a mere sprinkling on the laminae in the upper part of the topsoil and does not greatly influence the naturally dark color. The sprinkling, however, becomes increasingly concentrated with depth and the lower part of the topsoil may be almost white laminated silt in many places.

In many of the shallower basins the topsoils attain a thickness ranging from 15 to 18 inches and have the three layers, namely, the structureless, laminated, and granular, so characteristic of the topsoils in the Crete soils. The granular layer, however, invariably contains some white silt which is in many places sufficiently abundant to mask the naturally dark color of the lower granules and in a few places to produce a thin fourth layer of almost white laminated silt beneath the granular material. Downward-percolating waters have carried unusually large amounts of fine material from the topsoil to the subsoil, producing a somewhat denser claypan than occurs in the Crete soils. Moreover, the claypan is black in contrast to the brownish color of the corresponding layer in the Crete soils. In the moister situations the claypan contains black, spherical, concretionary forms from one-eighth to one-fourth inch in diameter. The black clay, which is practically structureless, ranges in thickness from 6 inches to 2 feet. It is extremely plastic when wet but checks and cracks severely on drying. Beneath the claypan is the lime zone, which is similar to the corresponding layer in the Crete soils. It is from 10 to 18 inches thick and overlies the loose floury unweathered loess from which the soils have weathered. The loess is not calcareous to a depth below 10 or 12 feet.

The group of poorly drained upland soils includes soils of the Fillmore and Butler series. The Fillmore soils occupy the deeper and more poorly drained depressions. The topsoils are thin and have not developed granular layers. The black claypan or upper subsoil layer contains scattered round black concretionary forms. The Butler soils occupy the shallower basins or better-drained parts of depressed areas. They have well-developed topsoils with pronounced structureless mulch, laminated, and granular layers. The claypan, although black, has not developed the round concretionary forms characteristic of extremely poor drainage. The soils, in fact, are transitional in character and development between the better-drained Crete soils and the extremely poorly drained Fillmore soils.

The imperfectly developed soils on hilly or rolling surfaces are very extensive in Franklin County, probably occupying a little more than 50 per cent of the total area. With the exception of the more sandy soils, they occupy hilly or steeply sloping areas where surface run-off has been rapid and erosion more or less severe. Conditions have been unfavorable for deep soil weathering, the accumulation of organic matter, the development of a lime zone, or the development of any of the characteristics resulting from prolonged undisturbed action of the soil-forming processes. The soils of this group, there-

fore, are not so fully developed as those of the more nearly level loess plains where the soil-forming processes have acted to their full capacity. The parent materials have not been so greatly altered by weathering and are still an important factor in determining the soil characteristics. However, all soils of the eroded group have made some progress in development, the degree depending on the severity of erosion, the comparative resistance to weathering of the different parent materials, and the length of time these materials have been subjected to the undisturbed action of the soil-forming processes.

The principal parent soil material of Franklin County is loess. In its unweathered condition it has a uniform floury texture and is composed largely of silt particles. It ranges in color from brownish yellow to almost white and is characterized by a tendency to split into vertical planes producing perpendicular bluffs along water-courses, roads, and other places subject to erosion. Lime is abundant, and a small content of iron stains the material in many places. This loess has given rise to all the soils of the smooth well-drained upland and terrace group, the flat upland group, and the poorly drained upland group. It has likewise given rise to the dominant soils of the eroded group, which are classed in the Colby series. In them the loessial material has not been so completely altered by the soil-forming processes as in the Holdrege, Hastings, Hall, and Crete soils and remains an important factor in determining the soil characteristics.

The Colby soils occupy steep slopes and sharp ridge crests, and erosion is severe. The weathered soil material and organic matter are removed almost as fast as formed. These soils have not developed definite zones or layers in Franklin County. The topsoils are lighter in color and thinner than those of the Holdrege, Hastings, or Hall series, being grayish brown or dark grayish brown and in few places exceeding 8 or 10 inches in thickness. They consist chiefly of finely granular material, although the perfection of granular development is largely influenced by the texture. In places where wind-blown sand is unusually abundant, the granules are very vague in outline and the material is more or less structureless. The topsoil rests either on very slightly modified loessial material or on the parent loess itself. In the rougher sections erosion has removed the topsoil in many places, exposing the light-colored loess and giving the areas of Colby soils a spotted light and dark appearance. The topsoil where present is locally calcareous and the underlying material naturally has a high lime content, but in Franklin County a zone of unusual concentration or segregation of the carbonates seldom occurs.

Soils of another series, the Nuckolls, have been formed under topographic conditions similar to those prevailing in soils of the Colby series but are derived from a parent material somewhat different in character and known in the Nebraska surveys as the Loveland phase of the loess. This material is pale-red friable silt containing some sand, chiefly of the finer grades. It underlies the lighter-colored practically sand-free loess of the uplands and is exposed only in the deeper valleys or more severely eroded parts of the county. Most of these exposures are on gentle or steep valley slopes, hill shoulders, and narrow divides. The Loveland material is thought to be an older loess than the overlying one. On the more gradual slopes or

flatter divides it has weathered into a soil similar to those of the smooth well-drained upland and terrace group except for a faint reddish cast in the subsoil. In fact the Nuckolls soils were fully developed belong in the former group, but since most of them in Franklin County are severely eroded they are included with the eroded group. The rapid surface run-off in most places has prevented a great accumulation of organic matter. The topsoils are very thin and composed largely of friable grayish-brown or dark grayish-brown granular material. They are underlain to a depth of about 15 inches by pale reddish-brown slightly more compact but granular silt loam which rests on the unweathered parent formation. On the steeper slopes erosion has removed the entire topsoil, exposing the reddish underlying material. The soils have not developed definite zones or layers except in the more protected or nearly level situations where they resemble the smooth well-drained upland and terrace soils.

The Bloomington soils, included in a third soil series of the eroded group, have weathered from the limestone and chalk rock formations of the region. These formations in Franklin County are exposed chiefly in the south-central part where erosion has removed most of the overlying parent soil materials. The relief ranges from strongly rolling to extremely rough and broken. The soils have been hindered in their development both by erosion and the resistant character of the rocks. They have, however, in the more nearly level areas developed definite though thinner horizons resembling those in the smooth well-drained upland and terrace soils. In the flatter situations the topsoils consist of three layers similar to those in the Hastings, Hall, and Holdredge soils. The subsoils, moreover, have developed rather definite layers of slight compaction and lime accumulation, but the parent rock is usually within 3 or 4 feet of the surface and the layers are necessarily thin.

Throughout most of the Bloomington soils in Franklin County the relief is too steeply sloping for normal soil development and one or more of the profile layers is absent. Much of the soil consists of a granular, usually dark-colored topsoil from 12 to 14 inches thick resting on more or less decomposed limestone or chalk rock which becomes firmer with depth. In many places erosion has entirely prevented soil formation. The white limy bedrock is exposed, and the material is classed as rough stony land.

Underlying the loess north of Republican River Valley are local sand or gravel strata which have been exposed by erosion. They have given rise to areas of coarse-textured soils which, on account of their prevailing uneven relief produced largely by stream or wind erosion, have been included with the eroded group of soils. In general the sand and gravel deposits have not developed true soil horizons. They are composed largely of gray quartzitic particles and their looseness and porosity have favored excessive leaching. None of the soils derived from the coarse-textured strata have retained a large amount of lime. The resistant character and the general instability of the sand and gravel have greatly retarded soil development. In many places the materials have been little altered since their exposure and in such localities are classed with dune sand, which consists of gray almost pure sand whipped by the wind into dunelike areas.

The only parts of the exposed sandy strata which have weathered sufficiently to be classed as soils belong to the Valentine and Derby series. The Valentine soils, although composed largely of gray fine or medium sand similar to that in the dune sand areas, have developed in more protected situations than those occupied by dune sand and have not been subjected to such severe wind action. They have therefore accumulated more or less organic matter and their topsoils are slightly darker than their subsoils. The organic-matter content, however, is nowhere sufficient to prevent soil drifting when the native sod is destroyed, and in cultivated fields the Valentine soils greatly resemble dune sand except in their more even relief.

The Derby soils are developed on sands, probably originally similar to those giving rise to dune sand and Valentine sand. The sands underlying the Derby soils, however, have evidently been exposed to weathering for a longer time than those under dune sand and Valentine sand, and prolonged oxidation has given the sandy material a decided reddish cast. The topsoils of the Derby soils, where well developed, are from 8 to 10 inches thick and have accumulated sufficient organic matter to make them dark grayish brown. Moreover, they contain much more silt and clay than the topsoils of the Valentine soils and are therefore more coherent. The reddish-brown subsoils have developed a zone of slight compaction in their upper layers, owing to translocation of the finer topsoil particles. The rather coarse sandy material, however, has not been sufficiently reduced by weathering to prevent excessive leaching, and the soils have not developed the layer of lime accumulation so characteristic of finer-textured loessial soils.

The Derby soils probably represent the most advanced stage of development of the soils derived from sandy material in Franklin County. The prolonged weathering to which the soils evidently owe their advanced development, especially with reference to their subsoil characteristics, may have occurred, in part at least, prior to deposition of the gray upland loess, but the dark color of the surface layers is evidently due to rather prolonged weathering subsequent to the removal of the overlying loessial layers.

The Derby soils in Franklin County occupy strongly rolling or hilly areas. Erosion in most places is severe, and the profile described occurs only in the flatter situations. Throughout most of the soils in this group the upper soil layers have been greatly thinned and in many localities entirely removed by erosion, exposing either the slightly compact upper subsoil layer or the reddish parent sand.

The alluvial soils have weathered from alluvial sediments deposited in the first bottoms of flood plains along streams during periods of high water. They have developed under drainage conditions similar to those prevailing in the poorly drained upland group of soils but from parent material of more recent origin and widely varying character.

The moist conditions prevailing in the flood plains have especially favored vegetal growth and decay and all the soils except those from the most recent alluvial deposits have dark-colored topsoils. The parent materials, however, are all of such recent origin that the soils have not developed true soil zones or layers. Oxidation and aeration have in most places been greatly retarded by excessive

moisture, and in many places the topsoils directly overlie the unweathered or only slightly weathered parent alluvial sediments. The character of the sediments, therefore, is important in determining the character of the flood-plain soils. The sediments carried by the local upland streams flowing through areas of loess are naturally uniform and silty. Similar sediments were carried by the larger streams before they became deeply entrenched, as is indicated by the uniformly fine texture of the Hall soils on the older terrace remnants along Republican River. As the larger streams became more deeply entrenched, however, their channels reached the sand sheet underlying the loess and the water-borne sediments were coarser. The mixing and re-assorting of the fine and coarse particles gave rise to a complete assortment of parent materials, especially in the Republican Valley as the sediments there came not only from the surrounding uplands but also from a variety of sources to the west.

The soils in this group which have weathered from coarse-textured sediments are classed in the Cass and Sarpy series. The Cass soils have accumulated considerable organic matter in their surface layers, which are very dark grayish brown or almost black. The Sarpy soils are poorly supplied with organic material and their topsoils are very light colored. River wash is also derived largely from coarse sandy sediments but has made practically no progress toward soil development and is not classed in any soil series. The subsoils of the Cass and Sarpy soils and the entire soil mass of river wash consist of gray incoherent sand and gravel.

The finer-textured flood-plain sediments in Franklin County have given rise to soils of the Lamoure series. The topsoils are almost black and are 12 or 14 inches thick. The subsoils are composed of silty or clayey material ranging in color from light grayish brown to dark grayish brown and containing an abundance of lime.

Owing to poor aeration and drainage the subsoils of all the flood-plain soils are more or less mottled with rust-brown stains, streaks, or splotches.

#### SUMMARY

Franklin County is in south-central Nebraska adjoining Kansas. It lies within the loess region of the State and includes parts of the loess plains and loess hills divisions. The loess plains range from level to gently undulating and the loess hills from rolling to extremely rough and dissected. The alluvial lands, including the terraces and flood plains, are prevailingly flat. They occupy a broad belt along Republican River in the southern part of the county and also occur as narrow strips along the numerous tributary creeks.

The average elevation of Franklin County is about 2,000 feet above sea level. The general slope is to the south and east.

The first permanent settlements in the county were made in 1870, and the county was organized in 1871. According to the census, the population in 1920 was 10,067. Franklin, the county seat and largest town, had 1,055 inhabitants in that year.

The climate is favorable for grain and hay production and the raising of livestock. The average frost-free season is 153 days.

Agriculture consists of the raising of livestock and the production of grain and hay crops. The greater part of the land is used for

diversified farming, although the rougher and more sandy parts are utilized for grazing and for hay production. The principal crops are corn, oats, wheat, alfalfa, and wild hay. Hogs are raised on every farm capable of producing corn and alfalfa for feed.

The soils of Franklin County have developed in a climate and under a vegetation favorable for the accumulation of much organic matter and lime carbonate. All the mature soils, therefore, have dark-colored surface layers and a zone of lime accumulation in their subsoils. Prolonged undisturbed weathering has also given a more or less finely granular structure to the topsoils and a cloddy or nut-like structure to the subsoils. All these characteristics are pronounced in the well-developed soils of the county. Fully developed soils occur only on the more level well-drained uplands and terraces where conditions have been favorable for undisturbed weathering, and the soil-forming processes have acted to their maximum capacity for long periods. Throughout the rougher, more sandy, and poorly drained parts of the county the efficiency of the soil-forming processes has been diminished and the soils in these localities have not attained full development. The soils of the county are in various stages of maturity and differ widely in character. They have been separated into 17 soil series, including 27 soil types and 2 phases of types. In addition 3 classes of miscellaneous materials including dune sand, river wash, and rough stony land are mapped.

The Holdrege, Hastings, and Crete soils are very productive. The Butler and Fillmore soils are not so well suited to crop production. Hall silt loam is similar to the Holdrege soils and is very productive and suited to all crops common to the region.

Nuckolls loam is very similar to the Holdrege soils, except for the reddish tinge in the subsoil. Derby sandy loam is included largely in grazing land. The Sogn soils are extremely rough and broken in places. Bloomington silt loam is similar in some respects to the Sogn soils but occupies the more nearly level areas. It is very productive.

Valentine sand has weathered from sandy deposits and is rather unstable. Most of this soil is used for pasture and hay land. The Colby soils range from hilly to extremely dissected, and erosion has prevented the accumulation of much organic matter.

The Bridgeport soils are low in organic matter and prevailingly light in color. Judson silt loam differs from the Bridgeport soils in the higher organic-matter content of its surface soil and in its lower lime content.

The Cass, Sarpy, and Lamoure soils occupy the bottom lands along streams and in places are subject to overflow during periods of high water.

The designations dune sand, river wash, and rough stony land are self-explanatory.



[PUBLIC RESOLUTION—No. 9]

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

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

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

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]



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