

**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
WEBSTER COUNTY, NEBRASKA**

BY

**LOUIS A. WOLFANGER, U. S. Department of Agriculture, in Charge,
and R. D. WOOD, Nebraska Soil Survey**



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**UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1929**

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SOIL SURVEY OF WEBSTER COUNTY, NEBRASKA

By LOUIS A. WOLFANGER, United States Department of Agriculture, in Charge, and R. D. WOOD, Nebraska Soil Survey

COUNTY SURVEYED

Webster County is in south-central Nebraska. Red Cloud, the county seat, is 138 miles southwest of Lincoln. The county is 24 miles square and comprises 573 square miles, or 366,720 acres.

Physiographically, Webster County is a part of the Prairie Plains Province. Although most of south-central Nebraska forms a broad, rolling plain mantled with loess, the surface has been modified by water and wind erosion. Republican River traverses the southern part of Webster County in an east-west direction. This river, with its tributaries, has been an effective agent in modifying the surface, especially in the southern part of the county. It is deeply entrenched. Its tributaries extend north and south, almost at right angles to its valley, and have split the edges of the level plain into long, fringed tongues of rather flat upland.

The land forms of the original plain and those produced by the dissection of Republican River and its tributaries are represented in four natural divisions or regions. From north to south these divisions are the flat northern upland, the rolling central upland, Republican Valley, and the southern hilly upland.

The flat northern upland, the largest of these divisions, extends across the northern tier of townships, except where it is interrupted by Little Blue River and its tributaries. For short distances, in places for several miles, the surface is monotonously flat, dotted here and there by small basins in which water stands after every rain.

The surface of the rolling central upland was originally level, like that of the flat northern upland, but it is now composed of a series of alternating north and south ridges and valleys. Long draws, tributaries of Republican River, extend northward into the plain to a line which approximates the southern boundary of the northern tier of townships. These have split the level upland into long, narrow tongues, each of which has its narrow upland plain surface. Where the loess is removed in small areas, as along the larger tributaries, the underlying sand and gravel beds are exposed, and sandy bluish-white hills and gravelly knolls occur.

The Republican River Valley crosses the southern tier of townships. The valley floor is about 200 feet below the upland. The valley

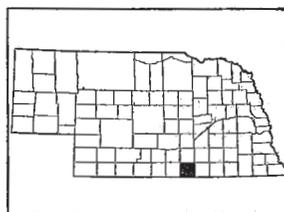


FIGURE 47.—Sketch map showing location of Webster County, Nebraska

averages less than 2 miles in width and is approximately 24 miles long. It consists of terraces, flood plains, old stream cut-offs, alluvial fans, and colluvial slopes. High terracelike forms are almost on the level of the uplands in the two western townships. Alluvial terraces occur on several levels above the valley floor. Where they are distinctly defined, they lie well above overflow and in places attain a width of a mile. The bottom land lies only 5 or 10 feet above normal water level and is flat, except where it is broken by sandy ridges and abandoned overflow channels. Republican River channel is shallow and rather wide. Its sandy bed is bordered in many places by low, sandy banks, but in other places prominent bench lands or higher flood plains form high and precipitous banks.

The southern hilly upland is a strip 4 miles wide just north of the Kansas State line. Lying close to the river, dissected by an intricate drainage pattern, and having a northern exposure, this part of the plain has experienced a heavy denudation of loess. The area, once level like the northern upland, is now reduced to a hill country of fairly rugged relief. Thick layers of limestone and shale, overlain by loess on the higher divides, are exposed where stream erosion has been severe. The narrow alluvial deposits along the larger tributaries of Republican River crossing this part of the county form, with a few exceptions, the only prominent flat areas.

Webster County has an average elevation of about 2,000 feet above sea level. Its general slope is southeastward. The altitude at Inavale is 1,728 feet,¹ at Red Cloud is 1,690 feet, and at Guide Rock is 1,650 feet. These towns are in Republican Valley. In the uplands Bladen has an elevation of 1,985 feet, Blue Hill of 1,970 feet, and Rosemont of 1,925 feet.

Republican River and Little Blue River are the principal drainage ways and, with their tributaries, are adequate to carry off all surplus run-off where the slope is sufficient to move the surface water. In general, Republican River, crossing the southern part of the county, drains the three southern tiers of townships by tributaries, most of which empty into the river within the county. Little Blue River drains the northern tier of townships. The major tributaries of both Republican River and Little Blue River have north-and-south trends, and their common divide is approximately 6 miles south of the northern boundary of the county.

In the flat uplands in the north-central part of the county and in a few depressions in the river valleys the slope is insufficient for good surface drainage. However, the total area of insufficiently drained land is not large. Physiographically, the drainage of the county as a whole is submature. Branches have ramified the largest part of the uplands. Little Blue River has not reached a local base level, but Republican River is slow and broadly meandering. Like the majority of the minor tributaries, Little Blue River is intermittent.

Webster County was established April 19, 1871. During the preceding fall it had been organized, for governmental purposes, as a precinct of Jefferson County. The first settlement was made near Guide Rock, a prominent bluff of the Republican Valley, where water and

¹ GANNETT. DICTIONARY OF ALTITUDES.

trees for shelter and fuel were easily obtained. Soon after the construction of a stockade for the protection of women and children, immigration increased rapidly. The native American population came from eastern Nebraska, Iowa, and States eastward, and a few settlers came from the South following the great stream of westward migration at the close of the Civil War. Germans and Bohemians came directly from Europe. Persons of Bohemian extraction are settled and loosely colonized in the central part of the county north of Red Cloud and in the vicinity west of Cowles; inhabitants of German origin occupy the northeastern townships. A few persons of French extraction are in the northwest corner, and Swedes and Danes are grouped near the west-central boundary. There are few negroes in the county. In 1920, 8,943 whites in the county were of native parentage and 3,084 were of foreign birth.

The total population of the county in 1880, according to the census, was 7,104, all classed as rural. In 1890, the rural population had increased to 11,210; in 1900 to 11,619; and in 1910 to 12,008. In 1920 it had dropped to 10,922. The decrease indicates the general readjustment of agricultural population which occurred in many parts of the United States during the decade between 1910 and 1920. The average density in 1920 was 18.9 persons to the square mile. This is about one-half the average density for the United States.

Red Cloud, the county seat and principal town, had a population of 1,856 in 1920. It is in the south-central part of the county in Republican Valley. Guide Rock, in Republican Valley, had a population of 611. Bladen, with a population of 445, Blue Hill with 726, and Cowles with 270, are located on the northern upland and are shipping points of local importance.

The main line of the Chicago, Burlington & Quincy Railroad between St. Louis and Denver traverses Republican Valley through the county. The Red Cloud-Hastings branch of the same system leaves the southern main line at Lester and runs northward through the county. The Holdrege-Nebraska City branch line of the Burlington Railroad traverses the northern tier of townships, and a branch line of the Missouri Pacific Railroad crosses the extreme northeast corner. All parts of the county are within 10 miles of a shipping point.

Most of the roads in the county follow section or land lines. Many of the State roads are graveled. The main dirt roads are generally graded and dragged after rains, but the minor ones receive very little attention, especially in the sparsely settled southern uplands. Heavy rains cause severe erosion everywhere. The Golden Rod Highway follows Republican Valley across the county, and State Highway No. 2 extends north from Red Cloud to Hastings in Adams County. Both highways are kept in good condition, maintenance being provided through the State highway system. Republican River is bridged near Guide Rock, Red Cloud, and Inavale. Telephones are in general use, and rural delivery routes reach all parts of the county.

In general, the rural schools are well distributed. Some districts have been consolidated. Grade schools are maintained in every town, and high schools are conveniently located. Churches are easily accessible.

The principal local markets in Republican Valley and vicinity are Red Cloud, Guide Rock, and Inavale. Cowles, Blue Hill, Bladen, and Rosemont are the principal local markets in the northern uplands. Some products are marketed in near-by towns in adjoining counties. Wheat is delivered to local elevators in all towns. There is a good local demand for much of the farm produce. Cattle are shipped into the county, chiefly from St. Joseph, although a few come from Denver. Most of the livestock is marketed in Kansas City and St. Joseph. Most of the hogs are shipped from the southern towns in the county. Wheat from northern towns is marketed at Omaha and from Republican Valley towns at Kansas City. Dairy products are sold locally.

CLIMATE

The climate of Webster County is characterized by cold winters, hot summers, fairly heavy summer rainfall, relatively low humidity, and a moderately long frost-free season.

Mean annual precipitation for the county, as recorded by the Weather Bureau station at Red Cloud, is 24.51 inches. Nearly 70 per cent of the rainfall in Webster County occurs in the form of thundershowers during the period from May to September, inclusive, and almost 70 per cent of this quantity falls in June, July, and August. Rains are sometimes torrential, and hail occasionally does serious damage locally. The rainfall, when favorably distributed, is generally sufficient for the crops grown. The wide range in rainfall, however, constitutes one of the most serious agricultural problems of the county, and its influence is recorded in the life of the community. The average annual snowfall is 22.8 inches.

The mean temperature for a period of nine months is above freezing, although the actual frost-free season averages only a little more than five months (159 days). The average date of the last killing frost is April 28, and that of the first is October 4. The latest recorded killing frost was on May 28, and the earliest was on September 11.

The most noteworthy characteristic of the climate is the continuous succession of changes which commonly occur every three or four days at all seasons of the year. Ordinarily the warm, cloudy, rainy days of summer are followed by short periods of cool, clear, sunshiny weather. In winter, the periods of cold weather and snowfall are periodically broken by short spells of warmer, clear, thawing weather which removes all the snow from the ground.

All seasons of the year are characterized by winds, but there are also periods of practically dead calms. The prevailing winter winds are from the northwest, and the summer winds are generally southerly. The hot, desiccating south winds are most damaging. The high winter winds are associated with cold waves and blizzards which pile snow in great drifts along fence rows and other obstructions.

Table 1, compiled from records of the Weather Bureau station at Red Cloud, Nebr., gives the normal monthly, seasonal, and annual temperature and precipitation for a period of 25 years.

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

[Elevation, 1,687 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1894)	Total amount for the wettest year (1902)
	° F.	° F.	° F.	Inches	Inches	Inches
December.....	27.6	69	-22	0.69	0.94	0.67
January.....	26.2	75	-28	.34	.20	.50
February.....	29.2	80	-25	.76	.51	.70
Winter.....	27.6	80	-28	1.79	1.65	1.87
March.....	40.4	98	-18	.79	.33	.89
April.....	51.9	98	10	2.50	1.04	.71
May.....	61.9	102	20	3.45	1.61	3.80
Spring.....	51.4	102	-18	6.74	2.98	5.40
June.....	72.4	106	38	4.43	3.97	7.75
July.....	77.4	108	46	3.81	.40	13.52
August.....	75.8	108	36	2.73	.07	1.99
Summer.....	75.2	108	36	10.97	4.44	23.26
September.....	67.6	104	24	2.73	4.59	5.75
October.....	54.1	94	11	1.43	.72	2.91
November.....	39.9	82	-7	.85	.03	.72
Fall.....	53.8	104	-7	5.01	5.34	9.38
Year.....	52.0	108	-28	24.51	14.41	39.91

AGRICULTURE

The history of the white man's occupation of Webster County covers a period of less than 60 years. In 1869, Webster County had no existence, nor was there a settler in Republican Valley north of the Kanas State line.² The following year 19 people, with several teams, came from Omaha and organized as the Rankin Colony for the purpose of forming a settlement in the broad, level valley of Republican River.

This band of settlers reached the present Webster County in early spring. They located along the river where water for men and animals could be obtained. By the beginning of winter (1870) there were settlers all along the valley. The construction of protective stockades near Guide Rock and at Red Cloud brought in additional settlers with women and children.

Farming constituted the earliest occupation. The first crop planted was the turnip. The main crop was sod corn, and yields were good because the soil was fertile and moist from the shallow water table. In 1872, spring wheat was introduced, and settlement spread from

² PETERS, E. EARLY HISTORY OF WEBSTER COUNTY, NEBB.

the valleys into the uplands. Crop yields there, however, were not always encouraging, and good yields were often followed by poor ones. The early plantings of spring wheat did fairly well, although the droughts were troublesome. The homestead act providing land at \$1.25 an acre gave only a quarter section (160 acres) of land to each settler, but after the passage of a modifying act in 1874, \$200 served to preëempt an extra quarter.

In 1874 droughts, combined with grasshopper attacks, affected the crops so adversely that many people left the county. By that time wheat was the chief cash crop, and corn and wheat were the staple crops. Oats and barley were of minor importance. Potatoes, peas, beans, tobacco, buckwheat, flaxseed, broomcorn, and sorgo (sweet sorghum) for sirup, were grown to some extent on many farms. About 1880, winter wheat was introduced, and since then spring wheat has been of only minor importance.

During the early settlement, most of the crops and livestock produced in the county were consumed locally. Corn was a common medium of exchange. The establishment of a railroad station at Hastings, about 35 miles north of Republican Valley, furnished the first opening to outside markets, and for several years the surplus wheat was hauled to that place.

The construction of the Chicago, Burlington & Quincy Railroad along Republican Valley brought in new settlers, stimulated development, and opened up new markets. As in other parts of the State, settlement was marked by advancements and recessions of population. The good crop years were followed by rapid settlement, and the periods of drought resulted in partial abandonment.

The type of agriculture changed gradually from grain farming to mixed grain and livestock farming, as the railroad opened new markets for surplus products. In 1890 farms averaged 190 acres in extent. Three-fourths of the land was improved, and farm tenancy was only about 8 per cent, the lowest reported percentage in the history of the county.

The ultimate improvement in agriculture was in part the result of a period of increased rainfall and in part of the experience which farmers had gained in the preceding years. It had become evident that neither the farm practices of the humid East nor the variety of crops grown there were adapted to the region and that both soil and climate called for new crop varieties and special farming systems. The farmers began to realize that a modified system of dry farming and stock raising, together with the use of seed better adapted to the drier soil and climate, were required in order to insure favorable yields in average years. By 1900, the corn acreage had increased 40 per cent over that of the past 10 years and was fairly stabilized. The wheat acreage increased 150 per cent between 1890 and 1900 and by 1910 had increased again more than 30 per cent. There was a steady increase in the average size of farms until it reached 223 acres in 1920. The ratio of improved to unimproved land is about 4 to 1.

The present agricultural system in Webster County may be designated as a modified Corn-Belt type of farming. Corn, wheat, hay, oats, and barley are the chief crops, and a large proportion of the average farm is pasture land. The most numerous farm animals are horses, cattle, hogs, and poultry. The primary object of the average

farmer is the production of grain and hay to fatten livestock. Wheat serves as a cash crop. Dairy and poultry products constitute an important source of income.

There is a general adaptation of the types of farming to the four physiographic divisions of the county. A large part of the flat northern upland is devoted to winter wheat. The central rolling upland and Republican River Valley are planted largely to corn and hay. The southern hilly upland is utilized mainly for grazing. None of the crops mentioned are raised solely in a single division but are produced, to varying extents, throughout every part of the county.

The soils of the flat northern uplands have compact and heavy-textured subsoils that retain moisture for the use of the wheat, and the uniform surface facilitates the extensive use of improved farm machinery. Owing to the variability of the rainfall from year to year, there is a wide variation in the acre yield of wheat. In years of sufficient and well-distributed rainfall average yields of 26.2 bushels to the acre (according to data published by the Nebraska State Department of Agriculture) have been obtained, and in seasons of deficient moisture the average yield for the county has been only 10 bushels to the acre.

The preparation of the ground for winter wheat is commonly begun about the first of August. Some seed is drilled in the corn rows in the fall, but most of the land is plowed and harrowed previous to seeding. Seeding time is usually about the middle of September. If the soils are light textured and in danger of blowing, a soil packer is sometimes used after planting. Wheat is harvested about the first of July, either with binders or headers.

Where the soils of the flat northern uplands are unsuited to wheat or where the surface does not favor the use of harvesting machinery corn and alfalfa often take the place of wheat as the crops of major importance. Rye, barley, sorghum, millet, and hay are minor crops. The bulk of the products is utilized for fattening cattle and hogs and as feed for work animals.

The typical farm of the rolling central uplands includes tracts of hill country and narrow strips of flat valley land. The chief exceptions are those farms which lie entirely within the larger valleys or on the broader divides. As a rule, however, most farms in this section include areas of hill land, some of which may be farmed but the rest of which are too rough for any use other than pasture. The chief grain crops in this division of the county are corn, oats, and barley, and the leading hay crops include alfalfa, wild hay, sorghum, and sweet clover. Minor acreages of all crops common to the region are grown. Many farmers devote a small percentage of their tilled land to winter wheat. The rolling surface does not lend itself well to the machine culture necessary in the economic production of small grains on a large scale. Soil erosion on most slopes even makes it questionable whether corn and other cultivated crops should be grown unless the land is terraced or otherwise protected from erosion.

Oats are used chiefly as feed for work animals. The acreage, therefore, is seldom large. Some of the grain is sold locally, but this is not a common practice.

Alfalfa, like corn, has high water requirements, and is grown on the prevailing upland soil with its moisture-retaining and usually limy

subsoil. Sorghum and millet are sometimes made a part of crop rotations and are often sown on soils that are subject to drought.

The inclusion of rough, dissected land within the average farm is another important factor governing the farming system. Most of this land is too steep or broken for cultivation, but it furnishes fair or good pasturage in favorable seasons.

The system of farming in Republican River Valley is based largely on the production of corn and hay for feeding livestock. The valley bottom lands are considered the most favorable in the county for corn, owing to the nearness to the surface of the underlying water table. The terraces, however, except the lower-lying ones, are subject to the same droughts as the uplands. The chief hay crops of the first bottoms are alfalfa and native grass. Alfalfa naturally yields well. Although the lowlands are not well adapted to small grains, owing to their sandy texture or poor internal drainage, wheat is locally grown as a cash crop, and some farmers sow small acreages of oats and other grains. Cattle, hogs, and work animals are fed most of the corn. A small acreage of pasture is on all farms.

Oats rank third among the grain crops in acreage. In general, oats are less profitable than other grains, but they are valuable in rotations and as a source of feed for work animals. This crop does not withstand droughts as well as other grains, suffers some damage from hot winds, and, like barley, is subject to damage by grasshoppers.

The acreage of barley is about one-third that of oats. Although it is hardier than oats, it also suffers from grasshoppers. Very little of the crop is marketed. Like oats, its yields vary widely from year to year, depending on the rainfall.

The cattle in the county are chiefly of the Shorthorn breed. The Hereford ranks second in numbers. This breed early found favor with the western range men because of its ability to thrive on scanty pastures where water holes or water tanks are far apart. There are also some herds of Aberdeen-Angus and Galloway, and a few dairy animals. Cattle for feeding are shipped in chiefly from St. Joseph, although a few come from Denver. According to the State census, there are from 20,000 to 25,000 cattle of all kinds in the county, the number varying with crop conditions. The greatest number is in Republican River Valley and in areas bordering this valley, but nearly every farmer throughout the county has a few cows. In the northeastern part dairy cattle, chiefly of the Holstein breed, outnumber the beef cattle.

The tendency within recent years has been toward approximately the same number of cattle and hogs. In 1922 the number of hogs surpassed the total number of cattle. Some hogs are raised on many farms, but the greatest number are in the southern part of the county along the river belt, where corn and alfalfa furnish ample feed. Most of the animals are raised and fattened on the same farm, though in some instances they are purchased locally or shipped in for fattening. A few hogs are killed for home consumption. The quality of the stock is, in general, high, and there is a strong tendency toward the use of purebred sires. Webster County is said to rank first in the State in the number of purebred hogs and about ninth among the counties of the United States. Poland China and Duroc-Jersey are the leading breeds represented. A few farmers practice crossbreeding for the

purpose of building up marketable types, but results are poor after the first generation. There is some loss through cholera, but outbreaks are neither common nor widely disastrous as proper sanitation and vaccination are common.

In the southern hilly uplands neither the soil nor the relief is, as a whole, suited to grain farming. The area is dominantly one of pasture and range lands. Locally corn, alfalfa, sorghum, Sudan grass, oats, barley, and other crops common to the region are planted on the better soils of favorable relief, but in some places entire sections (640 acres) of the chalk land or of badly eroded hills are devoted to pasture. The prevailing system of agriculture is one of feed-crop production for supplementing pasture.

Although the principal hay and feed crops are naturally obtained from the cultivated plants, wild grasses supply considerable hay. The grasses include bunch grass, western wheatgrass, and buffalo and grama grasses in the rougher sections and bluestem in the valleys. Yields vary from less than one-fourth ton to more than 1 ton to the acre, depending on the moisture conditions.

Both uplands and valleys are used for range and pasture. Many of the valleys are sufficiently smooth for cropping under the prevailing system of agriculture, but the smaller ones contain little plowland. Many of the drainage ways are deeply cut into the upland, and some reach the water table. Springs and intermittent stretches of perennial streams are, therefore, fairly common. The lowland supports scrubby clumps of elm, ash, and cottonwood. These trees supply shade for the cattle in summer and wind protection in winter.

Although the minor forage crops, including sorghum, Sudan grass, sweet clover, millet, kafir, timothy, and red clover, ranking in acreage in about the order named, are grown in all parts of the county, they assume a position of leading importance in the grazing zone. They have a high feed value, do not require cultivation, and produce large yields. With the exception of timothy and clover, which do better in more humid climates, all these crops are largely drought resistant.

Table 2 shows the acreage and yield of the principal crops from 1916 to 1922, inclusive; Table 3 the number of livestock in the county for the same period; and Table 4 the acreage of the leading crops in stated years from 1879 to 1919, inclusive, as reported by the census.

TABLE 2.—Acreage and yield per acre of leading crops ¹ in stated years

Crop	1916		1917		1918		1919	
	Acres	Yield per acre	Acres	Yield per acre	Acres	Yield per acre	Acres	Yield per acre
Corn.....	99, 108	<i>Bushels</i> 20. 5	129, 002	<i>Bushels</i> 16	100, 889	<i>Bushels</i> 11	78, 725	<i>Bushels</i> 16
Winter wheat.....	54, 141	19. 9	1, 680	13	69, 850	10	75, 350	13
Oats.....	11, 760	3595	26, 999	27	16, 807	12	12, 179	35
Rye.....	163	15. 5	269	14	1, 625	10	1, 742	12
Barley.....	136	30. 0	1, 396	26	3, 424	14	4, 440	26
Spring wheat.....	389	10. 0	1, 090	13	1, 097	8	773	7
Potatoes.....	555	87. 9	800	82	846	36	664	38
Alfalfa.....	24, 909	<i>Tons</i> 2. 6	19, 959	<i>Tons</i> 1. 8	22, 714	<i>Tons</i> 1. 8	22, 643	<i>Tons</i> 2. 3
Sorghum.....	-----	-----	-----	-----	3, 248	-----	4, 824	3. 0
Millet.....	-----	-----	-----	-----	-----	-----	852	1. 8
Wild hay.....	19, 212	1. 0	14, 458	. 8	18, 212	. 8	23, 550	1. 1

¹ 1916-1919, Annual Reports, Nebraska State Board of Agriculture. 1920-1922, Bulletins 107, 114, 123, Nebraska Department of Agriculture.

TABLE 2.—*Acreage and yield per acre of leading crops in stated years—Contd.*

Crop	1920		1921		1922	
	Acres	Yield per acre	Acres	Yield per acre	Acres	Yield per acre
Corn	94,284	<i>Bushels</i> 32	88,767	<i>Bushels</i> 19	84,922	<i>Bushels</i> 15
Winter wheat	61,212	18	67,166	14	75,076	10
Oats	15,701	38	14,401	29	12,203	17
Rye	890	19	894	12	471	12
Barley	4,298	32	3,808	27	4,661	16
Potatoes	618	103	684	52	738	62
Alfalfa	22,271	<i>Tons</i> 2.4	19,180	<i>Tons</i> 1.8	18,880	<i>Tons</i> 1.9
Sorghum	3,844	3.0	2,932	2.9	3,085	2.3
Millet	505	1.7	450	2.0	511	1.4
Wild hay	15,755	1.0	11,876	.8	13,131	.7
Sweet clover	743	-----	1,178	-----	1,496	-----
Sudan grass	900	3.2	1,152	2.8	3,818	2.0

TABLE 3.—*Livestock on farms, 1916-1922, inclusive*¹

	1916	1917	1918	1919	1920	1921	1922
Horses	9,004	8,984	8,836	8,755	10,846	8,562	8,495
Mules	2,328	2,228	2,041	1,680	1,686	1,843	2,065
Cattle	23,129	25,868	25,680	24,670	23,141	22,651	20,705
Hogs	20,884	20,867	20,928	17,996	15,148	19,025	24,201
Sheep and goats	164	240	192	322	664	792	644
Poultry	<i>Dozen</i> 10,949	<i>Dozen</i> 10,882	<i>Dozen</i> 11,071	<i>Dozen</i> 11,231	<i>Dozen</i> 10,635	<i>Dozen</i> 10,535	<i>Dozen</i> 11,381

¹ 1916-1919, Annual Reports, Nebraska State Board of Agriculture. 1920-1922, Bulletins 107, 114, 123, Nebraska Department of Agriculture.

TABLE 4.—*Acreage of principal crops in 1879, 1889, 1899, 1909, and 1919*¹

Crop	1879	1889	1899	1909	1919
Corn	<i>Acres</i> 28,415	<i>Acres</i> 81,288	<i>Acres</i> 114,529	<i>Acres</i> 114,337	<i>Acres</i> 81,948
Oats	2,765	24,191	25,716	11,980	11,464
Wheat	28,454	11,612	30,762	39,441	75,827
Rye	234	1,827	1,384	25	1,201
Barley	1,461	1,446	112	15	3,902
Alfalfa	-----	-----	76	26,273	20,867
Wild hay	8,563	28,780	19,970	21,210	15,266

¹ U. S. Census 1880, 1890, 1900, 1910, 1920.

A small part of the northeastern part of the county, included in the flat northern upland division, might be called the dairy zone. The general farming system is the modified Corn-Belt type, and dairying is extensively practiced. Markets and transportation facilities are excellent, and cream is sold in large quantities.

A few minor crops produced in the county are of general distribution and do not characterize any one region. These are chiefly potatoes, truck, and fruit, and as a rule are not produced for market. Nearly every farmer raises a few potatoes for home consumption. The yield and production vary widely with the character of the soil and rainfall conditions. Watermelons, cantaloupes, tomatoes, cabbage,

and other truck crops are grown to supply local demands. Little fruit is sold, except locally when a surplus exists. Apples, cherries, and peaches are the most common fruits, and there are a few pear and plum trees, grapevines, and strawberries. Fruits have been unprofitable, owing to unfavorable climatic conditions.

Work animals and poultry occupy a minor but important place on nearly every farm. Mules and horses, principally the draft types, are raised for work animals. The total number of mules has in recent years increased, while the total number of horses has slightly declined. The last census reports about 10,000 mules and horses in the county, with a value of about \$1,000,000. Most of the farmers raise their own work animals and sell the surplus locally. Most of the mares are grade animals, but the sires are usually purebred Percherons. The average farmer has five or six work animals.

Poultry is raised on every farm, and there is a good demand for poultry products. The average farmer is dependent on his flocks for ready cash and often for sustenance in poor crop years. Many varieties of chickens are raised, and many farmers keep geese, ducks, and guinea fowls. There is local adjustment of crops to both soil and surface features, although the adaptation of certain soils to particular crops is not observed by all farmers. Wheat is commonly grown on the smooth, level lands (Crete, Hastings, and Holdrege soils); corn on level or rolling land (Crete, Hastings, Holdrege, Nuckolls, and Valentine soils and on all terrace and bottom lands); and alfalfa on subirrigated bottoms, terraces, and rolling limy hill lands (Cass, Sarpy, Lamoure, and Hall soils). Fields on northern slopes are commonly considered the best for corn, and those on southern slopes are better adapted to wheat and the fine-rooted, drought-resistant sorghums and millets. The matter of situation is disregarded, however, by many farmers, though in dry seasons corn and other crops produce better yields on the rounded slopes and northward-facing valley sides than on the flatter uplands or south-exposed slope land. Practically no farming is done on the eroded valley slopes, which are suitable only for grazing. The wet and sandy bottom lands are used for pasture and hay production.

Alfalfa is planted on much of the bottom land of Republican River and many of its larger tributaries and on the friable valley-slope lands. Subsoil moisture conditions in such areas are favorable. Alfalfa does not do well on swampy land or on sandy soils. The heavy well-drained bottom lands are better adapted to corn than to small grains, as small grains often produce a rank vegetative growth and there is danger of lodging. For these reasons, the stream valleys present an almost endless succession of corn and alfalfa, mixed locally with grazing land and minor crops.

Modified cultural methods not practiced in the more humid parts of the State are employed in this county, owing to the lower rainfall and its variable distribution from year to year. On the nonsubirrigated lands, dry-farming methods variously modified to meet local labor and relief needs are practiced. Loose mulches are maintained to conserve moisture or the soil is left cloddy and rough surfaced to prevent blowing and to check run-off.

As a whole systematic crop rotations have neither been worked out nor consistently followed. Changes from year to year result partly

from occasional extremely droughty seasons which make adherence to a definite plan practically impossible. It is very probable that this condition will continue, with some improvements in seed selection and plant breeding, until increased population or a shift in the nature of our food supply forces the country as a whole to modify its system of agriculture. These changes may extend to the development and utilization of dry-land plants introduced from other countries.

The most common rotation in Webster County at the present time is from corn to wheat. Oats and barley may enter the rotation, but they are unimportant.

Practically no commercial fertilizers are used, and very little of the manure produced on the farms is applied to the land. Green crops are occasionally turned under, and considerable alfalfa is grown. The manure is usually spread in the fall or spring when farm work is light. On tenant farms most of the manure not left in the barnyard is applied only to land near the buildings. On the rough washed lands, the application of manure, accompanied by the growth of legumes to build up the severely eroded soils and maintain them in permanent cover crops, is a very desirable procedure.

As a rule, the farms are moderately well improved. Farms operated by owners are usually kept in much better condition than are the tenant farms. Houses and barns are generally kept in repair and painted. Hogpens are fenced with woven wire, and the farmsteads are fenced and cross fenced with barbed wire. Hedgerows, especially in the southeastern part of the county, often follow the land lines.

Within the home, modern improvements such as cream separators and other labor-saving devices are common. On the farms of Webster County in 1922 there were 60 homes with modern water systems, 37 with central heating systems, and 29 with central lighting systems.

Modern machinery is in general use on the farms. The equipment includes riding cultivators and plows, grain drills, disks, rakes, harrows, and mowers. Binders are used for wheat and corn. There is a fairly wide though not universal use of gas engines. Tractors are not common, as it is believed by many farmers that they are unsuited to the system of agriculture. In 1922, 336 gas engines and 93 gas tractors were reported in the county. There is a general tendency toward the use of mechanical power and machinery. In 1922 there were about 23 registered trucks on farms. Automobiles are common, there being an average of almost one car to each rural family. Only the more expensive machinery is sheltered. There are about 48 silos in the county.

Most of the farm work is done by farmers and their families. Neighbors exchange help, but outside labor is often scarce and hard to obtain when needed. The fairly large variation of crops tends to minimize the labor requirements, and there is not such a seasonal demand for labor as in more western or southern regions where wheat is grown almost exclusively. A single man is usually given his board, room, and laundry, and paid \$30 or \$35 a month when hired by the year. Maximum wages aggregating \$60 a month are sometimes paid to married men with families. When an entire family is employed, the use of a house and garden and some cows and chickens is given in addition to wages. Temporary labor is paid \$3 or \$4 a

day during the small-grain harvest and 6 or 7 cents a bushel for corn shucking. As there is considerable trouble in finding dependable temporary help, some farmers hire labor on a yearly basis.

In 1922 there were in Webster County 1,421 farms. These vary greatly in size, but the average farm in 1920 contained about 225 acres. The State census reports that 46.2 per cent of the acreage of the county was occupied by owners in 1922. The remainder was occupied chiefly by renters. Owners were on 39.5 per cent of the farms, part owners on 12.7 per cent, and renters on 47.8 per cent. Twenty-four per cent of the rented acreage is rented for cash and 76 per cent for a share of the crops. In leasing full tenant farms, about 9.3 per cent are leased for cash, 55.2 per cent for shares, and 35.5 per cent for a combination of cash and shares.

According to the Federal census, 76.5 per cent of the area in farms in 1920 was improved. The average farm had a value of \$22,567, of which 74.8 per cent represented land, 10.7 per cent buildings, 5.1 per cent implements, and 9.4 per cent domestic animals. The average acre land value was \$75.64. According to this report the farm animals are nearly equal in value to the buildings. Sixty per cent of the farmers in the county reported labor expenses averaging \$364 a farm, and 63 per cent of the farmers reported feed expenses averaging about \$597 a farm. The average labor cost has increased 178 per cent since 1910, when it was reported to be \$131 a farm. There has been about 30 per cent increase in feed expenses.

In 1922, slightly more than one-half (about 57 per cent) of the total area of the county was under cultivation and about 100,000 acres of the remainder were in pasture. No land is under irrigation.

The value of farm land in Webster County ranges from \$30 to \$150 an acre, depending on relief, character of the soil, improvements, and location.

SOILS

Webster County is in the region of the United States where the normally developed soils are dark colored. Throughout the county, regardless of the major land forms, the soils are predominantly dark in color, as the conditions under which they were formed have favored the accumulation and incorporation in the soil of large quantities of organic matter. The intensity of the color is naturally subject to local variations. Dark brown, dark grayish brown, very dark grayish brown, and other shades of dark color are present. The general contrast with the light-colored soils of the eastern and western parts of the United States is one of the most outstanding features.

The principal soils belong to the group in which lime has accumulated or is accumulating in certain parts of the subsoil. This characteristic indicates their relationship to the great division of soils known as the arid or semiarid group, the typical members of which are distinguished by an accumulation of lime in the subsoil. The humid soils of the eastern part of the United States are without lime accumulation, though lime may be present in the parent material from which they were derived.

In addition to the accumulations of organic matter, which have given the soils their dark color, and the development of a zone of lime accumulation, the soils are characterized by the fine granular structure of their surface horizons and the somewhat coarser but more com-

pletely granulated structure of their lower layers. These features are noticeable, especially in the older soils, regardless of the parent materials from which they have developed. The same generalization is true with regard to the dark color and the lime zone, both characteristics being independent of the underlying parent formations, especially in mature or well-developed soils. These characteristics are general features possessed in common by most of the soils of Webster County. In detail, however, the soils differ widely in color and other physical and chemical attributes. From top to bottom the average well-developed soil is composed of layers, the number depending on the stage of development the soil has attained. Variations not only in color but also in texture, structure, degree of compaction, and other characteristics of any layer are determining factors in the classification of a soil in any particular series or type.

The soils of Webster County vary in profile features with the relief of the land on which they lie, making it convenient to group them in three groups, as follows: (1) The smooth upland and terrace soils; (2) the rolling hill-land soils; and (3) the first-bottom or flood-plain soils. The group names are merely employed for convenience and are not intended as a classification based on the topographic position of the soils. The smooth upland and terrace soils have characteristics adjusted, therefore, to smooth, level areas, whereas the rolling hill-land soils are adjusted to rolling hill country. The third group, the flood-plain soils, have characteristics which are adjusted to high groundwater conditions and more recent accumulation of the soil materials.

The soils within each group have not all reached a mature stage of development. The members of the first group are, as a whole, mature, although there are slight differences between the several series included. The soils of the second and third groups, on the other hand, include largely immature soils.

As the name indicates, the smooth upland and terrace soils occupy the flat or gently undulating uplands and terraces, smooth, level stream divides, and long gentle slopes. In this situation erosion is at its minimum, and the processes which act on soil-forming material and create soils are presumably in operation with a minimum of disturbing conditions.

These soils, in their natural or uncultivated state, consist of five horizons or layers. The first three make up the surface soil; the last two the subsoil. The upper horizon, when present, is a grayish-brown, structureless dust mulch which varies from a mere film to 2 inches in thickness and is usually silt loam in texture. It is underlain by a laminated or platy zone in which the material is made up of small disks or platelike forms which rest in an approximately horizontal position and which are interlocked or overlapped in such a manner as to give the horizon a faintly layered appearance. This zone is generally darker than the surface mulch, being very dark grayish brown or almost black. It varies in thickness from one-half inch to 2 inches.

The third layer is dark grayish brown. It varies from 3 to 10 inches in thickness in the Fillmore soils to an extreme thickness of more than 18 inches in the Crete soils. It is characterized by its granular structure, the structure particles consisting of irregular aggregates which range from less than one-fourth inch to about one-half inch in diameter. This is called the granular horizon.

The fourth or upper subsoil layer is the zone of maximum compaction. It is composed of grayish-brown, olive-brown, very dark grayish-brown, or black heavy silt loam, silty clay loam, or clay. It ranges from 9 to about 30 inches in thickness. The presence of this layer in the profile is one of the most striking and characteristic features of the soils of this group. The grouping or arrangement of the structure particles in this layer may vary greatly in different soils. The particles may be grouped into irregular granules or small more or less prismatic clods, or they may have assumed no special arrangement.

The fifth or lower subsoil layer is also characteristic. It is the zone of lime accumulation. The material is in most places light or very light grayish-brown silt or silty clay loam which contains numerous soft or hard concretions of lime and also many white spots and splotches of similar composition. The lime, however, has been concentrated in the layer by soil-forming processes and does not merely represent the lime embodied in the parent material from which the horizon was formed. In some places the material below the zone of lime accumulation is without visible lime, but elsewhere the percentage of lime gradually decreases with penetration into the underlying deposits. The material, moreover, is generally without structure, breaking naturally into soft, angular clods of different sizes and shapes.

A soil series is made up of several members called types. The soil types have all the fundamental features of the series but are differentiated on the basis of the texture of the surface soil. Each soil type bears the series name and a textural designation, as Holdrege silt loam or Holdrege very fine sandy loam. A detailed description of uncultivated or virgin land for each of the series of soils in Webster County follows:

The surface soils of members of the Crete series are typically dark, ranging from dark grayish brown to very dark grayish brown or almost black. They are rather friable, are about 20 inches thick, and include three horizons, a structureless surface mulch from one-half to 2 inches thick, a laminated layer from 2 to 4 inches thick, and a granular layer about 15 inches thick. The granules in the lower layer are irregular and vary somewhat in size but in few places exceed one-fourth inch in diameter. The subsoil consists of two layers. The upper, which lies immediately below the granular horizon, is a true claypan and is the most compact layer in the soil. It is 15 or 20 inches thick and consists of olive-brown or dark grayish-brown, rather impervious, compact clay or silty clay. In a few places it has a slightly columnar structure. Although the dense clay is commonly structureless and breaks into irregular, angular lumps it may locally be more or less prismatic. When moist, a broken face of the horizon often presents numerous shiny surfaces. The lower subsoil layer is from 15 to 30 inches thick. It is soft, structureless, yellowish-gray or almost white silt containing scattered rust-brown stains and specks. To a depth varying from 4 to 6 inches the material is in many places transitional and may or may not contain lime. The remainder of the layer is calcareous, but the zone of maximum lime concentration is in few places more than 12 inches thick. It directly underlies the claypan or is separated from it by the transitional material mentioned. Within the zone of maximum carbonate concentration, concretions, spots, and

splotches of lime are numerous. Below this zone the visible lime gradually diminishes but disseminated carbonates are present in decreasing quantities to a depth varying from 5 to 7 feet, or the bottom of the horizon. Beneath the lower subsoil layer is the unmodified geologic formation from which the soil has weathered. This is soft, structureless, grayish-yellow silt loam or silty clay loam containing scattering rust-brown stains and spots. It is not calcareous to a depth of 4 or 5 feet. The soils of this series occupy well-drained level or gently rolling upland plains. The upper subsoil layer is intermediate in development between the heavy, almost black, structureless claypan of the Fillmore soils and the moderately compact, columnar, corresponding layer in the Hastings soils. Crete silt loam is mapped in this county.

The surface layers of the Hastings soils have a total thickness ranging from 20 to 28 inches. The structureless mulch is from one-half to 2 inches in thickness; the laminated layer is from 4 to 6 inches in thickness; and the granular layer is from 15 to 20 inches. The granules in the latter layer are well developed. In the subsoil, the layer of maximum compaction is about 12 inches thick. The material is grayish-brown or light-brown heavy silt loam or silty clay loam. It is moderately compact and is slightly heavier in texture than the layers above and below. It does not, however, have the density of a claypan. This layer is underlain in most places by a transitional layer below which is grayish-yellow loesslike silt. At a depth of 5 or 6 feet below the surface is a layer having a high lime content. This is the zone of maximum lime carbonate accumulation and consists of light grayish-brown silt loam in which lime occurs both in concretions and in finely disseminated form. Beneath the layer of lime accumulation is the loose, floury, grayish-yellow silt parent loess from which nearly all the soils of the region have developed. In this county only the silt loam member of this series has been mapped.

The Hall soils are very similar to those of the Hastings series except that their upper subsoil layers are commonly more compact, locally assuming claypan characteristics. The surface soils, which have a thickness of about 20 inches, consist of a very dark grayish-brown, loose, dustlike surface mulch from one-fourth inch to 2 inches in thickness, an almost black laminated or platy layer from 1 to 3 inches in thickness, and a layer of mealy or semigranular material about 15 inches thick. All horizons are friable. The subsoil includes two layers. The upper varies from 10 to 15 inches in thickness and reaches a depth of 35 or 40 inches. It is dark grayish-brown, is fine in texture, and varies considerably in density. However, it is invariably more compact than any layer above or below and locally may become extremely tight, assuming in places a claypan character. The material breaks naturally into irregular or more or less prismatic clods from one-half inch to 2 inches in diameter. The lower subsoil layer is light-gray or almost white floury silt containing an abundance of lime both in finely divided form and as numerous small concretions. It reaches a depth of 5 or 6 feet and is underlain by loessial material which is similar except for the lower percentage of lime present. All horizons beneath the laminated layer break vertically into columns from 3 to 5 inches in diameter. The Hall soils occupy well-drained smooth terraces. They differ from the members of the Judson series in having a zone of lime accumulation in their subsoils and from the

Cheyenne soils in the finer texture and greater coherence of their subsoils and substrata. Hall silt loam and a poorly drained phase of that soil are mapped in this county.

The soils of the Cheyenne series belong to the group of smooth upland and terrace soils, but they have developed from coarse sands and gravels which are resistant to weathering. In Webster County they are immature. They consist of coarsely stratified sands and gravels and occupy bench or terrace positions. They are largely associated with sand and gravel outcrops and deposits. They lie above frequent overflow and are more or less calcareous although there is no well-developed zone of lime accumulation. The surface soils are brown or grayish brown and the subsoils are lighter brown or yellow and are of similar or lighter texture. At various depths there is a substratum of porous sands and gravels. The gravelly sandy loam member of the series is mapped in Webster County.

The surface soils of the Fillmore soils vary in thickness from 6 to 14 inches. They are composed of a structureless upper layer from one-half to 1 inch thick, a laminated layer about 4 inches thick, and an imperfectly granulated layer which ranges in thickness from 3 to 10 inches. The two upper layers are very dark grayish brown or black, and the third is dark in the upper part but is more or less sprinkled with white, floury silt in the lower part. In places a thin, white floury layer is present. The subsoil consists of two layers. The upper is extremely dense, black, structureless clay which breaks into irregular clods of all sizes. It contains scattered hard iron concretions. The lower layer is gray, light-gray, or almost white structureless silt loam about 3 feet thick. Lime is abundant to a depth of 8 or 10 inches in this layer, chiefly in the form of concretions. Scattered rust-brown stains and specks are also present. Lime decreases in quantity with depth and is lacking below a depth of about 6 feet. Beneath these altered layers is the parent material of yellowish-gray floury loess. These soils occupy level or depressed areas on the uplands. The silt loam is the only member of the series mapped in Webster County.

The Judson soils have imperfectly developed texture and structure profiles. The surface layers are slightly darker than the subsoils, except where the latter include old buried soil horizons. The surface soils are generally dark grayish brown or very dark grayish brown, whereas the subsoils are grayish brown or brown. There is little texture variation in surface soil and subsoil, although lighter-textured streaks and thin zones are present in places in the deeper material. The soil is without a zone of lime accumulation, lime not even being present in the parent material so far as it was examined. These soils occupy gently undulating or sloping areas, and drainage, although good, is not excessive. Judson silt loam and Judson very fine sandy loam were mapped.

The soils of the rolling hill lands, although developed under the same climatic and vegetative environment as the soil of the smooth upland and terrace group, have profiles adjusted to rolling, sloping, and hill country. The group has, however, broad regional characteristics in common with the smooth upland group. The relief varies from steep to rolling, and drainage, particularly surface run-off, is

rapid and thorough. Subsurface drainage is also adequate and in some places is excessive. Soils of the Holdrege, Nuckolls, Sogn, and Valentine series are included in this group.

The soil of rolling Holdrege silt loam³ is not so deeply nor maturely weathered as are the typical Holdrege soils on the smoother uplands farther west. In this county these soils occur on the steeper slopes along stream courses and owe important characteristics to the fact that constant erosion has not given sufficient time for the accumulation of organic matter in the surface layer nor for the development of heavy layers in the subsoil. The rapid removal of the surplus water from the steeper slopes has not allowed the leaching of carbonates as fast as new material has been exposed at the surface. The grayish-brown, structureless, dustlike surface mulch is present but is rarely as much as 1 inch thick. The laminated layer is imperfectly developed or is entirely lacking. The third or granular layer is imperfectly developed and is thin, rarely exceeding 6 inches in thickness. The compact layer present in the Crete and Fillmore soils is entirely lacking, and the dark-colored surface layers rest on a silty material which differs little from the parent material. The subsoil layers are highly calcareous, and where erosion has been very rapid lime occurs in the surface soil. The parent material is the grayish-yellow loess which underlies nearly all the soils of the county. On the level areas of the Holdrege soils the unweathered parent material may lie at a depth of 6 or more feet below the surface, but the depth varies on the rolling land. On the very eroded slopes the parent material may come within a few inches of the surface.

The soils of the Sogn series occupy areas which in general have steeper gradients than those on which the Holdrege soils have developed. The parent material is unlike that which gave rise to the Holdrege soils. It is made up largely of Niobrara chalk, associated shales, and material derived locally from the overlying loess. The land, as a whole, is rugged, although smooth areas on some of the broader divides are included. The surface soils are from 6 to 18 inches thick, depending on the relief, are very dark grayish brown, rich in organic matter, and very friable. They are typically granular, the granules varying in diameter from one-sixteenth to about one-half inch. The subsoils are light grayish brown, contain numerous seams, spots, and splotches of white lime in the lower parts, and are rather friable throughout. Drainage is good, but the soils have not developed the well-defined layers characterizing the level upland soils. Sogn stony loam and a colluvial phase of the same soil are mapped.

The Nuckolls soils occupy gentle or steep slopes, hill shoulders, and narrow spurs and are irregularly distributed in many of the major and minor valleys of the county. The dark-brown or dark grayish-brown friable surface soils are underlain by lighter-colored reddish-brown, moderately compact but friable sandy clay loam subsoils. The parent material from which these soils have weathered is reddish loess or glacial outwash, older than the light-colored loess material from which the Hastings and Holdrege soils have developed. The surface soils have both a laminated and a granular horizon, but the former is in most places poorly developed. Although moderately compact the material of the layer of maximum compaction is easily

³ These soils are not true members of the Holdrege series but are imperfectly developed members of the Crete or Hastings. The true Holdrege soils have developed in a region of lower rainfall.

crushed between the fingers, its density being similar to that of the corresponding layer in the Hastings soils. A zone of lime accumulation occurs below the layer of maximum compaction, and the parent material may also contain some lime. Nuckolls loam is mapped in Webster County.

With the rolling hill-land soils may also be included the Valentine soils and areas of gravelly land occurring along many of the drainage ways where erosion has removed the gray and red loessial deposits and exposed parts of the underlying sand or gravel sheets. The exposed material has weathered but slightly, and the soils thereon have not developed definite horizons or layers such as would result from the weathering of less resistant material. The finer-textured sands, however, have accumulated a little organic matter, and their surface layers are moderately dark. The soils in general are composed of alternating layers of extremely incoherent sand of various grades and colors. Water percolates rapidly through the porous structures and has removed the lime and other easily soluble compounds. The Valentine soils are brown, sandy, and free from lime. In this county they occupy upland positions, although in other counties they also occur on valley lowlands. They contain very little organic matter. There is no layered or zone development, although the upper part of the soil contains more organic matter than the lower layers and is consequently somewhat darker in color. As a rule, the surface soils are brown, and the subsoils are light brown. Valentine loamy sand is mapped.

The soils of the flood plains or first bottoms are more poorly drained than those on the uplands, owing to the nearness to the surface of the underlying water table. The soil-forming materials include both coarse and fine sediments. As a whole, the location is far enough above the valley water table to provide fair drainage, except during overflow and in local depressional areas. The older sedimentary deposits have made some progress toward soil development and have more or less definite, although imperfect, profiles. At the present, however, the character of all the soils in this group is governed largely by the kind of sediment from which they were derived, and as the streams carry matter of a variety of textures, the alluvial material is naturally complex. The materials from which they are derived have been deposited so recently that the soil can be differentiated into little else than surface soil and subsoil. The subsoil, moreover, is simply unmodified parent material. The soils are also subject to continuous modification during overflow periods, and where they are adjacent to surrounding higher lands they are constantly receiving additions of surface wash.

The older soils derived from the coarser-textured deposits are included with the Cass series. They have dark surface layers, the colors varying from dark grayish brown to very dark grayish brown. The subsoils are lighter in texture and are brown, yellow, or gray, in many places stained with numerous rust-brown specks and splotches. They are composed of alternating layers of sands of various grades and thickness. A high lime content is characteristic of the subsurface layers, and in many places the entire soil is calcareous. The silty clay, silt loam, very fine sandy loam, and fine sandy loam of the Cass series are mapped in this county.

The younger soils derived from the coarser-textured deposits include members of the Sarpy series. They have light-colored surface soils. In all other respects they are similar to the Cass soils, although their average texture is somewhat coarser than that of the darker Cass soils. As a rule, they are closely associated with recent overflow areas. The deposits from which they are formed have been so recently laid down that the soil in most places is composed of alternating layers of stream sediment. Sarpy loamy sand and Sarpy gravelly sandy loam are mapped in Webster County.

The fine-textured sediments have weathered into dark-colored surface soils with slightly heavier and more compact dark-colored subsoils. The surface soils are dark grayish brown or black, but there is no striking color zonation except in some depressed areas where there may be a thin upper layer with a higher content of organic matter. The subsoils are as heavy or heavier than the surface layers. Internal drainage is inadequate, and the lower horizons show iron stains, gray splotches, and similar signs of poor drainage. Between overflow periods the soils normally have adequate surface drainage. These soils are grouped in two series, the Wabash and Lamoure.

The Lamoure soils have subsoils which vary from grayish brown to mottled gray or yellowish gray and which as a rule are heavier in texture than the surface layer. The subsoil is highly calcareous, and the surface soil shows the presence of lime in places. The lime occurs in both disseminated and concretionary forms, especially in the subsoil which is also commonly mottled, with gray, white, or rust-brown splotches and specks. The soils occur in depressed areas on the flood plains, are poorly drained, and are locally subject to overflow. They differ from the Cass and Sarpy soils in their fine texture and in the greater coherence of their subsoils. Lamoure silt loam and Lamoure silty clay loam are mapped in Webster County.

The Wabash soils are similar to the Lamoure but are noncalcareous. Both surface soil and subsoil are without lime reaction. The subsoil is commonly as heavy as or heavier than the surface soil, although in this county it rarely exceeds the surface soil in fineness of texture or in compaction. The color is normally dark grayish brown or very dark grayish brown, but locally the lower part of the subsoil is gray, in a few places having a bluish tinge. It is faintly mottled with rust-brown iron stains and inclusions of black carbonaceous material. The soil commonly occurs along the flood plains of the smaller drainage ways of the county. Wabash silt loam, light-subsoil phase, is mapped.

Rough stony land supports a thin growth of hardy grasses and hence merits classification, although it can hardly be classed as a soil. The hills comprising its area are merely low, rounded knobs occurring in the valley sides and are composed of small boulders, sand, gravel, cobblestones, and a little silty material which has blown in and lodged between the larger aggregates. Rough stony land is simply a geologic deposit of coarse materials which have not weathered sufficiently to be classed as a soil.

In the following pages of this report the various soils of Webster County are described in detail and their agricultural importance is discussed; their distribution is shown on the soil map which accompanies the report, and their names, acreage, and proportionate extent are given in Table 5.

TABLE 5.—*Acreege and proportionate extent of the soils mapped in Webster County, Nebr.*

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Crete silt loam.....	79,680	21.6	Sarpy gravelly sandy loam.....	2,240	0.6
Hastings silt loam.....	76,672	20.8	Sarpy loamy sand.....	1,664	.5
Holdrege silt loam, rolling phase.....	134,464	36.6	Lamoure silty clay loam.....	512	.1
Hall silt loam.....	12,352	3.6	Lamoure silt loam.....	192	.1
Poorly drained phase.....	704		Sogn stony loam.....	11,648	3.3
Wabash silt loam, light-subsoil phase.....	5,248	1.4	Culturial phase.....	320	
Judson silt loam.....	2,432	.7	Nuckolls loam.....	8,448	2.3
Judson very fine sandy loam.....	1,088	.3	Cheyenne gravelly sandy loam.....	1,088	.3
Cass silt loam.....	8,256	2.3	Valentine loamy sand.....	384	.1
Cass very fine sandy loam.....	8,256	2.3	Fillmore silt loam.....	320	.1
Cass fine sandy loam.....	2,240	.6	Rough stony land.....	7,168	2.0
Cass silty clay.....	1,344	.4			
			Total.....	366,720	-----

CRETE SILT LOAM

Crete silt loam is readily identified by the brownish color and compact claypanlike character of its upper subsoil layer. It is a prairie soil developed under climatic and topographic conditions favorable to the accumulation and retention of decomposed organic remains. Under native sod, it consists of five rather well-defined layers. The upper three, which comprise the topsoil, are a surface mulch, a laminated layer, and a granular layer. They have a combined thickness of about 20 inches. These layers are rich in organic matter and are dark in color, ranging from dark grayish brown to almost black. The surface mulch is from one-half to 2 inches thick and consists of silt loam, dustlike when dry. Silt and very fine sand particles are loosely mixed together with an abundance of plant roots and leaves. Most of the vegetative material is sufficiently decomposed to give the mulchlike covering a dark grayish-brown color. The second layer is about 3 inches thick and is composed of the same mixture of ingredients as the first, but the vegetative material is well decomposed, giving the layer a very dark grayish-brown or almost black color. The soil material is not loosely arranged as in the surface mulch but is grouped in thin, horizontal, and wedge-shaped forms which overlap one another, giving the layer a platy appearance. The two layers previously described are not present in cultivated fields, due to their thorough mixing and pulverizing through tillage operations. Their former presence, however, is largely responsible for the mellowness, high fertility, and favorable tilth of the soil. The third layer of the topsoil, the granular zone, is from 14 to 18 inches thick. It is friable but moderately heavy silt loam similar to or only slightly lighter in color than the laminated layer. The soil particles are grouped in granules, or small, irregular, and more or less angular forms from one-eighth to one-fourth inch in diameter. The smaller granules are most abundant in the upper part of the layer, where the color is apparently almost as dark as that of the laminated layer. The organic matter, however, is not uniformly mixed with the mineral soil particles, as it is in the overlying layers, but occurs chiefly as a film or coating on the surface of the granules. The film decreases in thickness with depth, and the lower part of the layer is dark grayish brown. Although the granular layer contains less organic matter to the unit of volume than the laminated one, its greater thickness gives it a larger total content of

this material and also makes it the chief reservoir of available food and moisture for the common cereal crops.

The subsoil of Crete silt loam includes two layers, a brownish-colored, very compact layer and a light-gray friable layer. Both are comparatively poor in organic matter. The former is immediately below the granular zone and continues to an average depth of 40 inches. It is composed largely of clay, is rather plastic when wet, and becomes very hard and tough when dry. The material breaks into irregular clods. The layer is readily identified by its dense or claypanlike character and is known by the farmers as the brown gumbo layer. The brownish color is imparted by a film of organic matter which covers the structure particles. Exposures of the claypan in dry road cuts present a coarse network of fine seams and cracks resulting from the shrinkage of the clay. The layer greatly retards water movement and is extremely resistant to penetration. 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. In it are white specks, splotches, and small hard or semihard lumps of lime. These are most abundant in the upper 10-inch or 12-inch layer of the horizon 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 classified in the Nebraska surveys as loess. It is very uniform in its composition to a great depth and is exposed in many places in deep road cuts or severely eroded hillsides throughout the uplands. The loess is very poor in lime to a depth greater than 15 or 20 feet.

The topsoil of Crete silt loam is fairly uniform throughout areas of the soil. The upper part of the subsoil or the claypan, however, varies somewhat in different localities, especially where the soil borders areas of the Hastings or Fillmore soils. In areas bordering the Hastings soils the claypan is more friable than typical, is commonly faintly columnar, and has a tendency to break into more or less prismatic units about one-half inch long. Where the soil borders areas of Fillmore silt loam the claypan is slightly darker than typical but otherwise remains unchanged. These variations are largely local and unimportant and are not shown on the soil map.

Crete silt loam is the dominant soil throughout the uplands in the northern part of Webster County. It occupies 21.6 per cent of the area of the county. The surface is nearly level, although it may locally be modified by shallow sags and slight elevations. Areas occupy the highest land in the county. The soil is adequately drained, although underdrainage is poor on account of the comparative imperviousness of the claypan layer. In most places the slope is insufficient to remove the surplus surface moisture.

Practically all of the Crete silt loam is used for the production of wheat, corn, oats, and alfalfa, which rank in acreage in the order named. In addition, some rye, vegetables, and forage crops are grown on most farms for home consumption. The acreage in wheat is probably 15 per cent larger than that in corn, and the total area devoted to either wheat or corn exceeds the combined acreage of all other crops mentioned.

Crop yields depend largely on the rainfall and the care used in managing the soil. The average yield of wheat over a period of years is about 15 bushels to the acre. The range is from less than 8 bushels in unusually dry seasons to 25 or 30 bushels in years of high precipitation. Oats yield from 15 to 50 bushels, depending on the season. Both wheat and oats mature before the hot, dry weather of midsummer and, since the readily available moisture supply of the soil is largely limited to the topsoil or that part above the claypan, these comparatively shallow-rooted and early maturing crops are well adapted to the soil. Corn and alfalfa, which require more moisture in larger quantities and for a longer period than small grains, give yields a trifle lower than on soils with no claypan development in their subsoils. Both crops, however, do rather well in favorable seasons. Corn yields from 5 to 30 bushels to the acre, averaging about 25 bushels. Alfalfa yields from one-half ton to 2 tons to the acre.

This soil is easily managed, considering its fine, silty texture. Clods are formed if it is cultivated when wet, but the lumps are easily reduced. The soil can be kept in good tilth with ordinary care.

HASTINGS SILT LOAM

Hastings silt loam is intermediate in its profile characteristics between Holdrege silt loam and Crete silt loam. The topsoil is dark and friable and continues to a depth of about 24 inches. In uncultivated areas it consists of a loose surface mulch from one-half inch to 2 inches thick, a laminated or platy layer from 3 to 6 inches thick, and a granular layer which occupies the remainder of the topsoil. All layers are composed largely of silt particles, although they contain some very fine sand and considerable organic matter. The organic matter produces the dark color. The surface mulch is loose, structureless, and uniform, and was probably carried to its present position by the wind. It is dustlike when dry. The organic matter is in various stages of decay, although there is an abundance of well-decomposed vegetation. The color of the layer is dark grayish brown. The laminated or platy layer contains a larger percentage of well-decomposed plant remains than the surface mulch and is very dark grayish brown or almost black. In this layer the sand, silt, and organic matter mixture is arranged in horizontal, platelike forms which overlap one another, giving the horizon its laminated or platy appearance. The granular layer contains a small quantity of clay, in addition to the sand, silt, and organic matter, and is consequently slightly firmer than the overlying layers. It is made up of irregular or semirounded aggregates from one-sixteenth to about one-fourth inch in diameter. The larger fragments are most abundant in the lower part of the layer. The organic matter in this layer is not thoroughly mixed with the mineral constituents, as it is in the overlying layers, but occurs chiefly as a film or coating on the surface of the granules. The film is thickest near the top of the layer and makes that part apparently as dark as the laminated layer. However, the true color of the material obtained by crushing the granules, thereby mixing their lighter-colored constituents with the dark exterior coating, is somewhat lighter than that of the laminated horizon. The film or organic matter becomes thinner with depth and the lower part of the granular layer is dark grayish brown or, when

pulverized, grayish brown. The structure particles in the granular horizon are larger, firmer, and more definite in outline than those in the third layer of the Holdrege soils.

The subsoil of Hastings silt loam includes two horizons or layers separated by transitional material. The upper, or the fourth layer in the profile, is the one of maximum compaction. It is from 10 to 14 inches thick and contains considerable clay, being moderately compact heavy silt loam or silty clay loam. It 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. The material is grayish brown or light brown and is considerably lighter in color than that of the granular layer. This lighter color results from the continued thinning of the film of organic matter which covers the structure particles. The zone, although much more compact than the corresponding layer in Holdrege silt loam, 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 where it joins the layer of maximum compaction, but it becomes grayish-yellow floury silt in the lower part. The material varies in thickness from 8 inches to 3 feet, but it commonly gives way to the lime zone about 5 feet beneath the surface. The lime zone or lower subsoil layer is light grayish-yellow or almost white, loose silt containing an abundance of lime in several forms. The silt has no definite structure but breaks into irregular clods. Beneath the lime zone is the unweathered or only slightly modified loessial formation from which Hastings silt loam has developed. The loess is commonly more or less calcareous, but its lime content to a unit of volume is less than that of the lime zone.

Hastings silt loam is rather uniform throughout the area of its occurrence in Webster County, although locally there are unimportant variations in the thickness, depth, and color of the various layers. The most important variation from typical is in cultivated fields, where the structureless mulch and laminated layers have become mixed. The characteristic structure of the laminated layer is destroyed, and the material above the granular layer is loose, structureless, or semigranular silt loam.

Hastings silt loam occurs in areas of various size throughout the smooth uplands and more gradual slopes north of Republican River. It occurs largely on narrow, flat-topped divides leading from the northern uplands to Republican Valley. Typical areas are on most of the divides north of Guide Rock, east, west, and south of Cowles, and in the vicinity of Rosemont. The soil is, as a whole, well suited to the use of large machinery.

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

This is one of the best upland soils in Webster County, and probably 90 per cent of it is under cultivation. 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.

HOLDREGE SILT LOAM, ROLLING PHASE

The surface soil of Holdrege silt loam, rolling phase, is dark grayish-brown or grayish-brown loose, friable silt loam 6 or 8 inches thick. This is underlain by a layer of darker-colored silt loam which, on eroded bluffs and slopes, is not more than 3 or 4 inches thick and on long gentle slopes, characteristic of a large part of the area of the soil, is from 10 to 15 inches thick. The material is composed of small, angular particles whose maximum size is less than one-fourth inch in diameter. This layer is commonly slightly heavier in texture than the surface zone. Like the surface layer, however, it is friable and easily broken. Below a depth varying from 12 to 20 inches, depending on the thickness of the upper layers, is the light-yellow or whitish silt loam of the subsoil. The change is commonly abrupt in both color and texture, the looser, more friable, and lighter-colored material being one of the outstanding characteristics of the soil at this depth. The material has the characteristic smooth, floury feel of the loess material from which it is derived, and it grades with depth, in many places within 3 feet of the surface, into the very light colored, unweathered parent loess. Lime concretions, splotches, and lime in powdered form are common, not only in the subsoil but also in the surface soil. Although in places the texture approaches very fine sandy loam and in the southern uplands of the county, where erosion and leaching are excessive, very heavy silt loam or almost silty clay loam, over the county as a whole there are not many variations from the typical silt loam. On the eroded slopes and rounded hills, the soil is thin and light gray or yellowish gray in color, the organic materials have been removed as fast as formed, and the grayish-white subsurface material is present within a few inches of the surface. On the gentler slopes of the drainage ways, however, and in the vicinity of their headwaters, the dark-colored surface layers continue to a depth of 15 or more inches before they grade into the lighter-colored parent material. These areas, compared with the former, are well supplied with organic matter, the quantity in places approaching that in typical Holdrege silt loam.

As is the case with the typical Holdrege soil, the floors of the many drainage ways ramifying this soil are mantled with colluvial wash and alluvial materials but are not separated on the soil map on account of their small extent.

This soil, owing to its topographic position, has not developed the same fundamental characteristics as the typical Holdrege soils of the uplands, although it has weathered from similar parent material. It has developed fairly uniform characteristics, especially where the native grasses have protected the soil from erosion, but as a whole the severe erosion which characterizes the soils in this county has prevented it from reaching maturity. It is extensive in Webster County, occupying the slopes adjacent to the valley of Republican River and its tributary drainage ways. The areas are irregular in shape and occur as narrow strips flanking the more open valleys of the larger drainage ways. The soil also occupies the minor divides of branching tributaries and mantles most of the sharper ridges lying adjacent to the drainage basins in the southern uplands of the county.

The surface of this soil ranges from almost level over small areas to steeply sloping on the eroded bluffs. The level areas are on the

small divides between drainage ways. The narrow strips along stream valleys are characterized by moderate or steep slopes and are rather deeply eroded in places. On the steeper slopes the uneven surface makes plowing and harvesting of crops rather difficult and detracts from the agricultural value of the land. Along the large drainage ways, especially Republican River, and along the lower courses of some of the drainage ways which empty into that stream or Little Blue River, the land is rolling or rough, with numerous minor steep slopes and precipitous bluffs. These streams have cut deep, abrupt, perpendicular-walled valleys into the originally level upland surface. Miniature landslides are common, and the slopes in many places present a succession of small steps.

Owing to the topographic position, drainage of the soil and subsoil is adequate. The subsoil on the smoother areas retains moisture remarkably well. It is this characteristic which makes the soil so well adapted to corn.

The native vegetation of the rolling phase of Holdrege silt loam consists chiefly of prairie grasses. On rolling areas subject to erosion, bunch grass predominates, and on the smoother areas buffalo and grama grasses are important. Areas too small for cultivation produce good growths of bunch grass for hay. From 5 to 7 acres are considered sufficient to support one horse or cow for a year, if the pasture is supplemented with feed during the winter months. The cattle are grazed on the rougher areas.

This is an important soil in this county and is one of the leading corn soils in the rolling central uplands. It occurs on most of the farms in the county. Probably not one-half of its area in the county is broken or under cultivation, the steeper and many of the more gentle slopes being included in pasture or hay land.

Corn is the principal crop on this soil, its acreage surpassing that of any other crop. Wheat and alfalfa rank next in importance. Oats, rye, barley, sorghum, and Sudan grass are the most important minor crops. Wheat is the chief cash crop. Wheat yields from 12 to 15 bushels to the acre, though 25 or 35 bushels and more are reported in exceptionally favorable seasons. In unfavorable years, however, production falls so low that some crops are not harvested. From 20 to 25 bushels to the acre is the usual corn yield over a period of years, but the range is as great as in the case of wheat. Maximum yields of more than 50 bushels to the acre have been reported under favorable rainfall conditions.

This is the leading alfalfa soil, not only in the Corn Belt of the rolling central uplands but throughout the uplands of the county. Its looseness and friability are favorable for corn, and its high water content makes it excellent for alfalfa. Alfalfa yields 2 or 3 tons to the acre from three cuttings, the yields and number of cuttings fluctuating with the season. Alfalfa is an excellent crop for the soil, as it prevents erosion, adds nitrogen, and increases the naturally low organic-matter content.

The average yield of oats and barley is about 25 bushels to the acre and of rye about 15 bushels. Sorghum gives good yields of forage, from 2 to 3 tons to the acre. Sudan grass which has more than quadrupled its acreage in the three years (1920 to 1922, inclusive) has yielded as high as $2\frac{1}{2}$ or 3 tons to the acre.

Owing to its friable and silty character, this soil is easily managed and can be cultivated under a wide range of moisture conditions. Although it has a tendency to clod when plowed wet, the lumps break easily. The greatest injury to which the soil is subject is washing on the steeper slopes, especially when it is planted to cultivated crops like corn. The furrows are inclined to develop into gullies.

Other than increasing the supply of organic matter and nitrogen by growing alfalfa, sweet clover, or other legumes no treatment is more important in the improvement of the soil than measures taken to prevent erosion. Erosion can be retarded by the construction of brush or rubbish dams along small drainage ways to check the run-off. The cost of this will be very small compared to the laborious efforts necessary to reclaim the land when it is ruined by gullies. Under the present economic conditions much of the soil, particularly that which occurs on rough and rolling land, should not be under cultivation to any crops except grass and forage which completely protect the surface from erosion. Contour plowing might be employed on the more gentle slopes and, under special conditions, the land may be terraced. Terracing, on the whole, is considered too expensive at the present time.

HALL SILT LOAM

The surface layer of Hall silt loam consists of a dark grayish-brown structureless silt loam mulch which ranges from one-fourth inch to about 2 inches in thickness. The material is loose but is thickly matted with grass roots. Locally the texture is very fine sandy loam. The second, or laminated layer, is very dark grayish-brown or almost black mellow silt loam from 3 to 6 inches thick. It is made up of small, approximately horizontal, disks or plates. These are so interlocked with one another as to give the characteristic laminated or platy appearance to the layer. When broken, the material disintegrates into very fine granules which vary from about one thirty-second to one-sixteenth inch in diameter. The particles are angular and have rounded corners. The fine grass roots cling tenaciously to the structure particles. The horizon is uniform in color, except for scattered spots of black, carbonaceous material. Pulverization yields a color which is only slightly lighter than that of a broken face. The material contains numerous worm casts.

The third, or granular zone, varies in thickness from 10 or 12 inches to about 18 inches. It is thicker on the higher terraces, where it is commonly marked by a differentiation into two subzones. The chief characteristics of the upper subzone are the fine, granular structure and the large number of worm casts. The material is very dark grayish-brown, finely granular, heavy silt loam. It is slightly lighter than the laminated layer, owing to its higher clay content, but is only faintly compact, crushing easily between the fingers. The resultant powder is only slightly lighter than a broken surface. The subzone is fairly uniform in color, except for a few spots and splotches of slightly lighter brown material. These seem to occur on granules or on groups of granules, but they occupy only a very small proportion of the total volume. The subzone differs from the laminated layer in its slightly lighter color, its somewhat greater density, and in the large number of worm casts, of which it is sometimes almost entirely com-

posed. Most of the casts are spherical, about half of the groups still retaining their surrounding cysts. The layer occasionally contains a very few small feldspathic pebbles. The lower subzone is very dark grayish-brown silty clay loam which is slightly more compact than the overlying soil. It contains numerous small spots and splotches of slightly lighter brown material. These give the zone a somewhat lighter shade than the layer above. The lower subzone also has a few worm casts, but most of them are no longer spherical. The cysts, which originally covered groups of casts, have been mostly destroyed or are only partly retained. The material of the layer can be broken with slight difficulty into a granular mass, the granules varying from one-sixteenth to one-fourth inch in diameter. When pulverized, the material is grayish brown. In some areas the faint columnar form which characterizes the zone of compaction begins to develop in this horizon.

The zone of maximum compaction is commonly not more than 10 or 12 inches thick. It consists of dark grayish-brown, moderately compact silty clay loam which is only a little lighter in color than the layer above but is decidedly more compact, has a higher clay content, a more pronounced columnar form, and contains fewer worm casts. The color is not uniform, as the layer is mottled and splotched with lighter brown. The material breaks into coarser aggregates than the layer above. When pulverized, the color is light grayish brown. The material of which this horizon is composed is crushed with difficulty between the fingers. As in the Hastings and Holdrege soils, there are occasional transitional layers between the zone of maximum compaction and the lower lime zone. This transitional material is light grayish-brown, heavy silt loam. It has a faint columnar form but no structure, breaking into rather soft, irregular clods. The material is friable, although it is a trifle more resistant than the average loessial material. When powdered it is only slightly lighter than a broken face, and it contains very few worm casts or canals and only scattered filled-in root cavities. The material of the root cavities is decidedly more compact than the surrounding matrix and is slightly darker in color. This transitional layer is commonly not more than 6 or 8 inches thick. The lime zone begins at a depth of 3 or more feet below the surface. It is very light grayish-brown, loose, floury silt, or silt loam which is a trifle more coherent in the upper 2-foot layer than in the remainder of the horizon but which can everywhere be crushed readily between the fingers. It contains an abundance of lime, both as soft and hard concretions and in powdered form. In some places animal burrows 5 or 6 inches in diameter are filled with dark grayish-brown or almost black granular silt loam. The structure is pronouncedly columnar, the columns being about 5 inches in diameter. It resembles unweathered loess in all respects except in the scarcity of iron stains and in its greater lime content.

The profile just described is that of the mature well-developed soil which commonly occurs on the high terraces of Republican River. Owing to the wide extent of the soil, however, and the many local modifications there are numerous variations both in the number and character of the several layers. The areas which occur on the south side of the Republican River occupy gentle colluvial slopes at the foot of the Niobrara chalk bluffs and outcrops. These soils have only

faintly developed laminated horizons, and the granular zone is thin and is made up of dark yellowish-brown, fairly compact silt loam. The lower part of the subsoil contains small admixtures of very fine sand and is gray or light gray in color. Locally there is some texture variation in all the zones, including the one of maximum compaction. In a few places the profiles show old surface-soil layers throughout the subsoil section, indicating the presence of an old buried soil. The variations just described are especially characteristic of those soils which occur along the terraces of Little Blue River and along the upland margins of some of the large terraces of the Republican River Valley.

In addition to these variations numerous areas too small or too indefinite to separate on the soil map are included. These contain an unusually large proportion of very fine sand in their surface soils and approach very fine sandy loam in texture.

A large percentage of the Hall silt loam, as mapped in this county, includes a variation which might be designated as the high-terrace phase. The soil is very similar to the typical in all its significant features. It occupies very high old terraces whose surfaces lie about 100 feet above the present stream channels. These land forms occur only in the Republican River Valley, few extending more than a short distance along the tributary drainage ways. The principal development is along the north side of the river, where the soil forms a belt of moderate width at the foot of the upland.

Hall silt loam is the most extensive terrace soil in the county. It mantles both high and low terraces of practically every large valley. It has weathered largely from reworked loessial deposits. In its typical development it has reached maturity, although as mapped it includes numerous areas which have both imperfect color and texture profiles.

Drainage of this soil is good, although the surface slopes only very gently downstream. Areas are cut here and there by the drainage channels of watercourses crossing from the uplands, but erosion is not rapid. Ordinarily the open structure permits the ready absorption and movement of moisture. Most of the soil is not subject to overflow, but it is locally modified by the deposition of alluvial material, especially where it borders the lower courses of small tributaries issuing from the uplands.

Owing to its high organic-matter content, favorable structure and texture, and wide distribution, this soil is important agriculturally. With good farming methods it is easily kept in a productive state. Most of it is under cultivation. The high content of organic matter and the friable consistence tend to make it drought resistant.

Originally Hall silt loam was covered with a thick growth of native prairie grasses, including bluestem, wheat, buffalo, and grama grasses. Most of the soil is now under cultivation. The principal grain crops are corn, wheat, and oats. Alfalfa is the leading hay crop. All yields compare favorably with those obtained from the Hastings and Holdrege soils and locally, especially in areas which are favorably situated to accumulate the surface run-off from higher levels, yields are slightly higher. Corn yields from 20 to 50 bushels to the acre, wheat from 10 to 30 bushels, oats from 25 to 40 bushels, and alfalfa from 1 to 3 tons from three cuttings. The larger yields depend on the quantity and distribution of the rainfall.

The farming system employed is ordinarily one of combined grain farming and livestock production. Most of the crops produced, with the exception of wheat, are used on the farm to feed the work animals, hogs, dairy cows, and beef cattle. Some farmers have a surplus of corn and oats, which are sold to local buyers. In the smaller valleys where this soil is associated with upland areas of rough, rolling Holdrege soils or other pasture soils, its inclusion in the farmstead constitutes a good economic balance. The cultivation methods are similar to those on the level upland soils. The soil is easily managed and is comparatively exempt from excessive denudation and leaching. No commercial fertilizers are used, as the soil is both strong and fertile. It is not in immediate danger of exhaustion. Barnyard manure, however, is applied locally. In this way the supply of organic matter of the soil and its good tilth are maintained.

No definite crop rotations are practiced, but rotation is being given more attention by many farmers. There is an increasing tendency to change crops with some regularity.

Hall silt loam, poorly drained phase.—The surface soil of Hall silt loam, poorly drained phase, is dark grayish-brown or very dark grayish-brown friable silt loam, 10 or 12 inches thick. The subsoil consists of two layers. The upper part is dark-gray or dark grayish-brown, heavy, compact silty clay loam from 12 to 20 inches thick, and the lower part is tough, dark grayish-brown or dark-gray silty clay which is smooth and plastic when wet and hard and brittle when dry. Both surface soil and subsoil are rich in organic matter, the quantity decreasing slightly with depth, but they are noncalcareous.

There is little variation in this soil. Locally the subsoil is light brown in color or the texture grades toward silt loam. There is also a small inclusion of fine sand or fine pebbles, but this material does not affect the hard, tough nature of the subsoil. In some areas lime is present in places in the lower part of the subsoil.

This soil occurs along the low terraces of the large drainage ways in the county, only one area near Guide Rock being mapped in Republican Valley. The areas are small and widely scattered, most of them occurring as long, narrow strips.

This soil was developed under poor drainage conditions, but topographic changes have improved drainage. The surface is flat, with a gentle slope downstream. Drainage is fairly good over much of the area, in spite of the heavy texture of the surface soil and subsoil, as the land lies adjacent to established drainage ways or is high enough to drain well.

Poorly drained Hall silt loam has only local importance, owing to its small total extent. Practically all of it is under cultivation. The chief crops are corn, wheat, oats, and alfalfa. The yields compare favorably with those obtained from typical Hall silt loam. Most of the corn and forage are fed to hogs and cattle, since this soil occurs in conjunction with other land which plays an important rôle in the corn-cattle-hog farming system of the county.

No commercial fertilizers are used, cropping methods being similar to those on the other heavy soils of the county. The soil is very strong, fertile, and easy to manage. It is not in immediate danger of exhaustion and in favorable seasons ranks with the leading soils in the county.

WABASH SILT LOAM, LIGHT-SUBSOIL PHASE

The surface soil of Wabash silt loam, light-subsoil phase, is dark-brown or dark grayish-brown smooth silt loam 10 or 12 inches thick. It is underlain by dark-gray or very dark grayish-brown friable silt loam or loam which commonly continues to a depth of more than 3 feet without change in texture or great change in color. Although the surface soil is rich in organic matter, there is a gradual decrease in the quantity with depth. The lower part of the subsoil, however, is not commonly deficient in organic matter. Pockets of sand occur in both the surface soil and subsoil. Small iron concretions and iron stains, faint brown or rust brown, are present in many places in the lower part of the soil. Neither the surface soil nor subsoil is calcareous.

This phase of soil differs from typical Wabash silt loam in the character of its subsoil. As a whole, it is a correlative of Judson silt loam, but it occurs on flood plains and low bench situations where it is subject to occasional overflow.

This soil presents some variations from typical. In places the subsoil is heavy, brownish-gray silty clay loam, similar to Wabash silt loam. Locally, small lime concretions or nodules are scattered through the subsoil. These are derived in part from the larger concretions of the upland loess and in part from Niobrara chalk. The lime particles are largely unaltered since deposition and are mere inclusions deposited during overflow. Small areas of silty clay loam are included with this soil as mapped, as are also narrow flood-plain developments along many of the larger ravines in the southern hilly uplands and in Republican Valley. These areas are lighter in color than typical, and there is often little change in color or texture between the surface soil and subsoil. These soils are calcareous, the high lime content being derived from the Niobrara chalk into which the ravines have been cut. In textural profile, the ravine soil is not unlike Wabash silt loam, light-subsoil phase, as mapped elsewhere in the county, but both the surface soil and subsoil are lighter in color and are calcareous.

Included with this soil is a small area of Wabash very fine sandy loam, located in the southern part of sec. 8, T. 2 N., R. 12 W., near the junction of two Republican River tributaries, one of which drains a sandy, gravelly soil. The surface soil of this area consists of a 10-inch layer of friable grayish-brown very fine sandy loam which is mottled and iron stained and which passes abruptly into dark-gray or bluish-black heavy, impervious silty clay loam rich in organic matter. The soil is poorly drained and contains no lime.

Wabash silt loam, light-subsoil phase, is widely distributed in the county. It occurs typically on the floors and low terraces of the large drainage ways in the northern three-quarters of the county, and small calcareous areas occupy the flood-plain floors of the small drainage ways. The strips range from a few rods to more than a quarter of a mile in width. Because of the scale of the map, many of the areas are too narrow to show, but the soil mantles the floors of the initial flood plains of nearly every drainage way in the county.

Areas of this soil are almost level and are dissected only by the stream channels of the major valleys and their tributaries. Surface drainage is generally adequate. The structure of the soil and sub-

soil favors the movement of internal moisture, and the surface has a slight slope downstream and toward the axis of the valley. Much of this soil is not subject to overflow except in unusual freshets, and none of the areas exhibit the poorly drained subsoil conditions of the typical Wabash soils. In a few places water stands on the soil after each inundation or heavy rain.

About 40 per cent of this soil is devoted to the production of the staple crops. The areas not in crops are used for pasture and hay land. The native vegetation consists of the prairie grasses, grama, buffalo, wheatgrass, and bluestem.

Corn is the principal grain crop and alfalfa the chief cultivated hay crop. Corn does well and has been grown on the same land for years without showing a marked decrease in yield. Occasional overflows seem to maintain the fertility of the soil. Yields are usually high, for the crop has the advantage of good moisture conditions caused by the run-off from the adjoining higher areas. The small grains are not grown so extensively, owing to their tendency to grow too rank and lodge in wet years, but some oats, barley, rye, and wheat are usually planted. Corn yields from 25 to 45 bushels to the acre, oats from 35 to 50 bushels, wheat from 15 to 30 bushels, and alfalfa from 2 to 3 tons a season.

The livestock industry is well developed, as on the strips of Wabash silt loam, light-subsoil phase there are drainage ways, some of which carry water at least through a part of the year. Where this soil occurs in conjunction with areas of the rougher Holdrege silt loam, rolling phase, it is used for pasture. Dams are often built for holding the surface run-off in small ponds for the use of livestock.

This is an excellent grass soil, and where good native grass growths do not exist the land may be sown to alfalfa or other tame forage crops which will furnish pasturage to cattle and hogs. The livestock industry consists of winter fattening of beef cattle, hog raising, and sheep feeding. Since the soil occurs in narrow strips with extensive tillable upland soils of the Holdrege, Hastings, and Crete series adjoining, the narrower bottoms are used entirely for pasture. Dairying is not important.

There is no common crop-rotation practice. Corn commonly succeeds itself but is occasionally alternated with oats or wheat. Owing to its friability, the soil can be worked under a wide range of moisture conditions. It is rich in organic matter, and no commercial fertilizers are applied as the productiveness is maintained by wash from the upland soils. The flat surface, silty texture, and friable consistence make the larger areas of this soil very desirable for farming.

JUDSON SILT LOAM

The surface soil of Judson silt loam is brown, dark-brown, or nearly black, loose, friable silt loam 15 inches thick. It is underlain by friable material of about the same texture, ordinarily light brown but commonly variable in color. The shade, however, is commonly lighter than that of the surface soil, owing probably to a lower content of organic matter, though both surface soil and subsoil are rather rich in organic matter. In general, there is little change in structure or texture to a depth of 3 feet, though there is an occasional suggestion of compaction or of thin, heavier horizons.

This soil is poor in lime and typically does not effervesce with acid. Locally, however, the lower part of the subsoil consists of light-gray, highly calcareous silt 30 or more inches thick. Locally also the soil profile shows old soil lines and old surface soil materials throughout the subsoil section, these layers indicating the presence of old buried soils. In many places, the surface soil contains a large proportion of very fine sand, and in some areas, noticeably along the terraces of Little Blue River and Republican River Valley, the texture is loam.

Judson silt loam is inextensive throughout the county. It is largely the result either of colluvial action representing the downward movement of silt from the higher silty upland soils or the weathering of silt and very fine sand carried in by the streams when they flowed at higher flood-plain levels. It is of comparatively recent origin, and sufficient time has not elapsed to develop the distinctly lighter colored subsoil characteristic of the older alluvial terraces. The soil occurs near the foot of the slopes between the terraces and uplands and between the uplands and first bottoms of Republican River, Little Blue River, Elm and Walnut Creeks, and other streams. Although it is not, as a rule, subject to overflow, it has been modified by alluvial action, especially where it occurs at the point of emergence of small tributaries carrying heavy loads of sediment.

Drainage is good. Ordinarily the open-structured though not porous subsoil permits the ready absorption and movement of surplus moisture. The location of many areas of this soil near the mouth of minor drainage ways which discharge on its surface results in good moisture conditions, even in seasons of prolonged drought.

The surface is almost flat, with a slight slope in the direction of adjacent streams. The land is cut here and there by the drainage channels of watercourses crossing from the uplands into the larger valleys, but it is not subject to rapid erosion.

Owing to its high organic-matter content and favorable structure, texture, and moisture conditions, this soil is important agriculturally and with good farming methods is easily kept productive. Most of it is under cultivation. It is considered equal to Hall silt loam in productiveness.

The principal crops on this soil are corn, oats, and alfalfa. The native vegetation in untilled areas is a dense growth of native grasses. Corn occupies the largest acreage and gives yields ranging from 10 to more than 35 bushels to the acre. The yields are above the average of the county.

The livestock industry includes the feeding of beef cattle, dairy cows, work animals, hogs, and a few sheep. Most of the crops produced are fed on the farm, but the surplus corn and oats are sold. This soil is one of the most important corn-producing terrace soils in Republican River Valley.

Cultural methods are similar to those on Crete silt loam and Hall silt loam. The soil is easier to manage than the upland soils and is comparatively free from denudation and leaching. No commercial fertilizer is used.

Although the areas of this soil are small and do not include entire farmsteads, Judson silt loam increases the value of other lands included with it. It has an average selling price of about \$90 an acre.

JUDSON VERY FINE SANDY LOAM

The surface soil of Judson very fine sandy loam is dark-gray or dark grayish-brown silty very fine sandy loam, 8 or 10 inches thick. It is friable, smooth, rich in organic matter, and commonly contains a considerable percentage of silt and some clay. The upper part of the subsoil is light-brown or light-gray very fine sandy loam, slightly lighter in both color and texture than the surface layer. The material continues to a depth varying from 27 to 30 inches, where it becomes gradually lighter in color and looser in structure, grading into loose light-gray very fine sand which continues to a depth greater than 3 feet. The transition between the different soil layers is very gradual in color, texture, and structure. The supply of organic matter decreases with depth and is very small below a depth of 30 inches. The soil is noncalcareous to a depth of 3 feet, unless lime fragments have been carried into it from higher-lying areas. Locally small amounts of lime are in the lower part of the subsoil, and the substratum below a depth of 4 feet is highly calcareous in places.

The textural variations are toward the heavier loam and silt loam soils, both of which are included in small patches in the areas mapped. These heavier textures are especially pronounced near the slopes from which silt and clay have been carried and deposited over the surface in irregular patches. As in Judson silt loam, the subsoil shows many evidences of old soil lines and buried soils.

Judson very fine sandy loam is inextensive in Webster County. Its total area is not so great as that of Judson silt loam. This soil occurs only in small patches and narrow strips along the larger tributaries of Republican River, but it broadly mantles many of the terraces of Republican Valley. The larger areas are between Red Cloud and Guide Rock on both sides of the river.

This soil has been formed in the same way as the silt loam of the series. Its larger content of very fine sand is probably due in part to the coarser nature of the alluvial sediments and in part to the presence of sand and gravel deposits in the near-by uplands.

This soil occupies benches or terraces, most of which are high above overflow of the major valley streams along which they lie but are subject to shallow sheet-water discharge of the small tributaries. Although the surface is nearly flat, there is a gentle slope downstream, and along the valley margins, where the land borders higher slopes, there is a noticeable dip toward the axis of the valley. Drainage is thorough but not excessive.

Judson very fine sandy loam is agriculturally rather important in the county. It is naturally strong and fertile, has a high content of organic matter, and is well adapted to all crops common to the region. Most of it is under cultivation. The original native vegetation consisted of the same grasses that grew on the upland soils of the county. Corn, alfalfa, and oats are the leading crops. Some wheat is grown, but the total acreage of this grain is small. Corn yields from 10 to 35 bushels to the acre, oats from 20 to 40 bushels, and alfalfa 2 or 3 tons of hay. Alfalfa is cut two or three times, depending on the season. The moisture conditions of this soil make it well adapted to alfalfa. Judson very fine sandy loam is one of the important terrace soils in the production of corn and alfalfa in Republican Valley.

Judson very fine sandy loam is easily managed and can be cultivated under a wide range of moisture conditions. It is slightly more retentive of moisture than the silt loam member of the series, on account of its looser structure, and crops seldom suffer from pronounced dryness except during periods of prolonged drought.

Commercial fertilizers are not used, but barnyard manure is applied to prevent the soil from blowing. The supply, however, is seldom adequate.

CASS SILT LOAM

The surface soil of Cass silt loam is grayish-brown or dark grayish-brown heavy, friable silt loam from 10 to 15 inches thick. It contains considerable organic matter and, in places, a rather high percentage of very fine sand. The subsoil is grayish-brown, light-gray, or light yellowish-gray very fine sandy loam or silty very fine sandy loam, mottled in places with rust brown and becoming lighter in color with increasing depth.

The subsoil presents some variation from typical. In a few places, the upper part is light-brown silt loam which grades abruptly into the typical gray or light-gray very fine sandy loam of the lower part of the subsoil, at a depth varying from 20 to 25 inches or even 30 inches. In other places the subsoil consists of alternating strata of silt and very fine sand, each several inches in thickness, the number depending on the number of deposits of different materials by the streams. Locally, the lower subsoil layer is medium or fine sandy loam, which is very porous and mottled with yellow and rust brown. The change from surface soil to subsoil is in most places abrupt both in color and texture. The surface soil is in few places calcareous, but the lower part of the subsoil commonly effervesces freely with acid.

A few areas of Sarpy silt loam too small to map are included with mapped areas of this soil. This included soil differs from Cass silt loam only in its lighter color and lower content of organic matter in the surface soil. Near the margins of the areas the soil grades into very fine sandy loam and silty clay loam.

Cass silt loam occurs along the first bottoms of Republican River and its larger tributaries. It is one of the most extensive flood-plain soils in the county. The larger areas occur in the eastern two-thirds of the valley. The surface is flat, except in a few places where it is modified by narrow, elongated depressions. The soil is practically all subject to overflow in years of excessive rainfall. Drainage, however, is adequate for crop production between flood periods. The loose, porous subsoil affords internal movement of water, and the surface is sufficiently sloping to slowly remove the surplus surface moisture.

About 75 per cent of this soil is under cultivation. It is naturally strong and fertile and is well adapted to most crops common to the region. Corn, oats, barley, and alfalfa are the leading crops. They do well and give good yields in all but the driest and wettest seasons. Corn yields from 35 to 50 bushels, oats from 30 to 35 bushels, and alfalfa from 2 to 4 tons to the acre. Alfalfa is usually cut three times. As on all bottom-land soils, oats ordinarily grow very rank, and the short-straw varieties must be planted to give good returns.

Cass silt loam is easily managed and can be cultivated without injury under a wide range of moisture conditions. On account of the looseness of the subsoil and the friability of the surface layer, the soil is slightly superior to Cass silt clay.

Definite rotations are not used by most farmers, but crops are changed irregularly every few years. Alfalfa is planted very extensively and tends to interfere with short rotations. No commercial fertilizers are used, but much of the barnyard manure available is applied in the spring and fall.

CASS VERY FINE SANDY LOAM

The surface soil of Cass very fine sandy loam is grayish-brown or very dark grayish-brown very fine sandy loam, from 10 to 15 inches thick. The change from surface soil to subsoil is abrupt in color but typically is not abrupt in texture. As a rule the subsoil is more open than the surface soil. The percentage of sand increases with depth in many places, the texture grading to very fine sand or fine sand at a depth of 36 or more inches. The subsoil is commonly gray or light grayish brown. The surface soil is mottled with rust-brown iron streaks. It is rich in organic matter and is almost black when wet. The subsoil is very deficient in organic matter. The surface soil commonly contains no lime, but the subsoil is highly calcareous.

Included with this soil in mapping are a number of areas of heavier material, varying in texture from silt loam to clay, which are too small to indicate on a map of the scale used. A 3-foot profile of this variable soil shows alternate layers of various thickness and texture, each representing a stage of overflow.

Cass very fine sandy loam, like Cass silt loam, occurs along the bottoms of Republican River and its larger tributaries. The larger areas are in the main valley, but narrow, elongated strips, some of them more than a mile long, are along the larger tributaries.

This land is prevailingly flat, but locally it is modified by old cut-off stream channels and elongated, shallow depressions. Like other soils occupying first-bottom positions, Cass very fine sandy loam is generally subject to overflow. In many areas lying adjacent to the river channel, the banks cave badly, owing to the loose structure of the material. The floods, which usually come during the growing season, sometimes destroy the crops by depositing coarse material or clay on the surface of the soil.

This soil lies from 5 to 15 feet above the stream channels. Surface drainage is adequate, although water accumulates after rains in the shallow depressions. As a whole, the water table lies near the surface, and crops rarely suffer from drought. The subsoil is especially moist, there being enough clay present to prevent complete drying out.

Cass very fine sandy loam is very important in the agriculture of Republican Valley. It is one of the most extensive soils of the flood plains. Its structure makes it easy to work, and it can be cultivated under nearly all moisture conditions. It has enough body to rank as a fairly strong soil. About 75 per cent of it is under cultivation, and the remainder is devoted to grazing. The native vegetation consists of the common marsh and prairie grasses, with marginal strips of timber along the stream channels. The principal trees are

cottonwood, willow, elm, box elder, ash, and hackberry. Slough grass, cat-tails, sedges, and other water-loving plants abound in the lower areas.

Corn, the principal cultivated crop, produces from 30 to 50 bushels to the acre. Alfalfa yields 3 or 4 tons to the acre from three cuttings. Small grain is not commonly grown on this soil on account of the difficulty encountered in obtaining a firm, compact seed bed and on account of the danger of lodging. Potatoes, garden vegetables, and melons do well, as the soil warms up early in the spring and contains sufficient moisture to give good yields.

Owing to its sandiness, this soil can be worked in the spring before most of the other bottom-land soils and is among the first to become sufficiently warm for seed germination. No commercial fertilizers are used. Barnyard manure is applied, but the supply is not adequate.

CASS FINE SANDY LOAM

The surface soil of Cass fine sandy loam is dark grayish-brown or very dark grayish-brown, loose fine sandy loam, from 10 to 15 inches thick. This is underlain by brown, loose loamy fine sand which continues to an average depth of 24 inches. The lower part of the subsoil is loose, incoherent, gray or yellowish-gray fine sandy loam or fine sand which commonly continues to a depth greater than 3 feet. In places considerable coarse sand and gravel are present between depths of 24 and 40 inches. The surface soil is commonly well supplied with organic matter, but the subsoil is deficient in this material. There is no abrupt change between the surface soil and the upper part of the subsoil, in color and texture. Over the greater part of the soil, however, the transition between the upper and lower subsoil layers is rather abrupt. The surface layer and the upper part of the subsoil are not calcareous. The lower part of the subsoil contains considerable lime and effervesces freely with acid. In many small areas the surface texture varies widely from typical. Because of their small extent and local occurrence it was not found advisable to separate such areas on the soil map.

Most of the Cass fine sandy loam occurs in disconnected small areas and narrow strips on the flood plains of Republican River. The total area is $3\frac{1}{2}$ square miles. One of the largest areas is about 4 miles west of Red Cloud.

This soil is flat, modified largely by local depressed areas. Owing to the light texture, loose consistence, and porous structure of the soil, drainage is good and cultivation is easy. In wet years, the soil is subject to overflow and modification by the deposition of flood débris.

Cass fine sandy loam is not important agriculturally, owing to its small extent. Most of it is farmed. The areas adjacent to the river channel support stands of mixed timber composed largely of cottonwood, willow, and elm.

Corn and alfalfa are the principal crops, and both do well. The soil is also excellent for melons and truck crops. Corn yields from 20 to 35 bushels and alfalfa from 2 to 3 tons to the acre. The areas included in pasture land support a good growth of native prairie grasses, principally sand grass and bluestem. About 1 ton to the acre is the average yield of hay.

This soil is easily tilled and can be worked under a wide range of moisture conditions. Corn is listed in. Small acreages of small grains are sown, but these crops do not do well on account of the looseness and sandiness of the seed bed.

Corn commonly succeeds itself for several years, and no crop rotation has been worked out. No commercial fertilizers are used, but some barnyard manure is applied. The manure supply is inadequate. The light soil is exhausted easily, and the supply of organic matter could profitably be increased. Continuous cropping to corn tends to reduce greatly the fertility of this soil on most farms. The most important method of improving the soil is to plow under vegetable matter to increase the naturally deficient supply of organic matter.

CASS SILTY CLAY

The surface soil of Cass silty clay consists of dark grayish-brown or almost black plastic silty clay, 10 or 15 inches thick. The subsoil is gray or yellowish-gray very fine sandy loam or fine sandy loam containing rust-brown spots, white specks, and other signs of imperfect drainage. In many places the material below a depth of 20 or 24 inches consists of alternate layers of very fine sand and silt and in others the entire subsoil is heavy, sticky silt loam or silty clay which grades into loose fine sand or very fine sand at a depth of about 36 inches. The surface soil contains a large quantity of organic matter. Although the texture is heavy, the soil breaks down into a fairly granular mass when plowed under proper moisture conditions. It is sticky and plastic when wet but crumbles readily on drying. Undecayed plant remains occur in places in the upper part of the subsoil and the lower or more sandy part is characteristically calcareous.

Cass silty clay has a wide distribution in Republican Valley, occurring in disconnected areas of various size across the entire county. Most of the areas are elongated and very irregular in shape. A large and typical one is just west of Inavale. The soil owes its origin to the silting up of old river channels and to backwater conditions during periods of overflow, when sediments are deposited on the flood plain.

The surface of this soil is flat, except in a few places where it is relieved by shallow, elongated depressions. Internal drainage is fairly good because of the looseness and porosity of the subsoil, and although the water table lies close to the surface the soil is adequately drained between overflows. The heavy-textured surface horizon retards the movement of moisture, with the result that the surface soil may puddle if it is worked after heavy rains.

Although its total area is not large, Cass silty clay is an important bottom-land soil as it is strong and well adapted to all crops grown in the region. About 75 per cent of it is under cultivation; the remainder supports a good growth of native prairie grasses and scattered clumps of trees. Corn and alfalfa are the principal crops. Corn yields from 25 to 50 bushels to the acre and alfalfa from 3 to 5 tons an acre from three cuttings. Hogs are raised on most farms, but not many cattle are raised, as most of the land is used for crop production.

This soil is rather difficult to manage on account of its high clay content, but it can be worked under most moisture conditions except excessive wetness or dryness. If plowed when wet, clods are formed. These are not easily broken down in later cultivation.

No definite rotation is generally practiced although crops are changed irregularly every few years. Alfalfa is planted very extensively. The water table is within easy reach of its long root system.

No fertilizers are used on this soil, but some barnyard manure is applied in an effort to maintain fertility.

SARPY GRAVELLY SANDY LOAM

The surface soil of Sarpy gravelly sandy loam is brown or light-brown, loose, incoherent loamy sand or sandy loam which contains a high percentage of fine gravel. It is underlain by coarser sand and gravel which extend to a depth greater than 4 or 5 feet with little perceptible change in color.

There are a few variations in this soil as mapped. Small areas having heavier-textured surface soils are included. The material in these was washed from the neighboring uplands or carried in by streams and deposited heterogeneously over the sand and gravel, causing the soil to be decidedly spotted.

This soil occurs in long, narrow strips along the larger tributaries of Republican River, where it occupies the narrow bottoms or flood plains. As a whole, the areas are not continuous but are separated by strips of soil having a heavier texture. Most of the soil occurs in close association with rough stony land, from which its coarse sediments are, in part, derived.

The surface is flat. Drainage is excessive, owing to the porosity of both the surface soil and subsoil.

Sarpy gravelly sandy loam is not highly valued for agriculture, and comparatively little of it is cultivated. It has a very low content of organic matter, and crops suffer from lack of moisture during dry seasons. It is also largely subject to overflow. Corn, watermelons, cantaloupes, and alfalfa are the chief crops grown. Corn produces only fair yields, but alfalfa and melons do well if the season is not too dry or floods do not occur. The best use of this soil is for pasture land.

SARPY LOAMY SAND

The surface soil of Sarpy loamy sand is light-brown or light grayish-brown loamy sand or sandy loam from 10 to 15 inches thick. This grades into lighter-colored sand, the texture remaining about the same to a depth greater than 3 feet but in places becoming coarser below a depth of 48 inches. Both surface soil and subsoil are generally loose and incoherent, but locally the surface horizon may contain considerable silt and clay and may approach very heavy sandy loam or silt loam in texture. This variation occurs principally in the small pockets or depressions throughout the soil. The supply of organic matter is fair in the surface soil but is very small in the subsoil. Owing to the coarseness of the material, the subsoil is only locally calcareous.

In many places, this soil contains layers of sand of various grades. The subsoil contains iron stains which vary in color from rust brown to reddish yellow. The soil is not uniform, except over small areas, and small patches of other soils are included within its outlines. In places where the surface soil has been left unprotected, it has been largely removed by the wind, exposing an almost white, incoherent fine or medium sand subsoil. A few small areas of river wash are also included.

Most of this soil occurs in narrow elongated areas in stream-meander loops on the flood plains of Republican River. The areas are not continuous but are isolated from each other by bodies of heavier soils. This soil was formed from coarse stream sediments deposited in periods of high water.

Areas of Sarpy loamy sand are flat or gently billowy. The surface is largely a series of low ridges with intervening depressions. Both surface and underdrainage are excellent, owing to the porosity of the sand, but the soil is not droughty, owing to the nearness of the underlying water table.

This soil is not important agriculturally because of its small total area. About one-half of it is in cultivation, principally to corn and alfalfa. The yields are slightly lower than those obtained from Cass fine sandy loam. The native vegetation of the pasture areas consists largely of bluestem and the sand grasses. Sand burs are common and troublesome weeds in both pasture and field. The areas bordering the river channel support a good growth of cottonwood, elm, ash, box elder, willow, and some mulberry.

This soil is easily managed and cultivated but is poor in organic matter and rather unstable. Some manure is applied, but the supply is insufficient. Melons do well without fertilization. Truck crops, such as squashes, cucumbers, pumpkins, and tomatoes, do well in favorable seasons.

Because this soil is so deficient in organic matter, every available means should be utilized to supply this material. Plowing under green crops, planting legumes, and making heavy applications of barnyard manure will greatly increase its producing power. The land should be kept in alfalfa or other cover crops in order to prevent the soil blowing.

LAMOURE SILTY CLAY LOAM

The surface soil of Lamoure silty clay loam, to an average depth of 10 inches, consists of very dark grayish-brown, dark-gray, or almost black tough, refractory heavy silt loam. The material grades into gray or light-gray intractable, extremely compact and impervious silty clay which continues to a depth of about 30 inches. As a rule, no coarse material is present in either the surface soil or subsoil, and both have a smooth, velvety feel when dry. The lower part of the subsoil consists of heavy, tough, gray or light-gray silty clay or silt loam. Both subsoil layers are mottled with gray, white, and brown specks, splotches, and streaks. They are very hard when dry but plastic when wet. The surface soil is poor in lime, but the entire subsoil is highly calcareous. The high lime content of the subsoil is the basis of distinction between the soils of the Wabash and Lamoure series. The surface soil is rich in organic matter, which gives it the

dark color, but the organic-matter content decreases rapidly with depth and there is an abrupt color change between the surface soil and upper subsoil layer.

There are few variations from typical. Locally, lime does not occur within 3 feet of the surface. In some places the lime in the subsoil is mainly in the form of concretions. In places there are a few mottles of rust brown and yellowish brown. As in Lamoure silt loam, streaks and seams of sand materials occur, but these do not affect the general nature of the soil.

Lamoure silty clay loam is mapped only in the Republican River bottoms, where it is found chiefly in narrow, elongated, irregular areas. The soil occurs in flat areas having only slight elevations and in depressions.

Surface drainage is poor, and small alkali spots are of local occurrence. Subsurface drainage is also deficient, the imperviousness of the subsoil combined with the depressed situation obstructing free drainage movement of ground water. When artificial drainage is provided the soil is fertile and highly productive.

This soil is not important agriculturally, owing to its small total area and to the difficulty in working it. The surface soil has a tendency to crack and form fissures of moderate depth and width. Where mechanical disintegration is complete the surface often has a buckshot appearance. In the proper moisture condition the character of the soil is such that cultivation is easy, but if cultivated when wet the material puddles and becomes compacted.

A considerable part of this soil, probably 50 per cent, is under cultivation. The uncultivated areas support a heavy stand of grasses among which grama, buffalo, salt, and wheat grasses are the most common species. These areas are used largely for grazing and for the production of hay. The most important cultivated crops are corn, oats, and alfalfa. Corn yields from 20 to 50 bushels, oats from 25 to 50 bushels, and alfalfa from 2 to 4 tons to the acre, depending on the season. Alfalfa does especially well on this soil, for its lime requirements are met in the high lime content of the subsoil and its roots find abundant water after penetrating the heavy upper subsoil layer.

No regular crop rotation is practiced, as the soil is high in fertility. Heavy horses are usually employed because of the heavy texture of the soil.

LAMOURE SILT LOAM

Lamoure silt loam, to a depth of 10 or 12 inches, consists of grayish-brown or dark grayish-brown heavy friable silt loam containing comparatively large quantities of organic matter. The subsoil consists of two horizons. The upper zone is dark-gray or brownish-gray, compact, tough, resistant silty clay loam which continues to a depth varying from 20 to 30 inches. The lower subsoil layer is yellowish-gray silt loam or silty clay loam which is distinctly calcareous and lighter in color than the upper layer. The higher lime content of the subsoil is the principal mark of distinction between Lamoure silt loam and Wabash silt loam, the lime not having been leached to such a great depth in the former soil.

Textural variation in the surface soil embraces a range from silt loam to light silty clay loam, but the silt loam is dominant in area

and uniformity. Streaks of sandy material in places alternate with the clay loam in the subsoil, but the heavy character of the clay material is constant and preponderant. Some of the lime occurs as concretions and iron stains, and yellowish-brown mottles are common. Small alkali spots occur locally.

This soil occurs in a few small areas on the first bottoms or flood plains of Republican River. The areas are flat, and the surface slope shows only a slight gradient down valley and toward the stream channel. As a rule drainage is poor owing to topographic characteristics and the imperviousness of the subsoil.

This soil was originally prairie, and only a small part has been brought under cultivation owing to the small extent and minor agricultural importance of the land. The native grasses furnish good hay or pasturage. Corn is the principal grain crop. The usual yield under favorable moisture conditions is from 35 to 50 bushels to the acre. Wheat and oats do well but tend to grow rank and lodge in wet seasons. Native grasses yield from 1 to 1½ tons to the acre.

With adequate drainage this soil gives good yields of all crops common to the region. Owing to its high fertility, slow exhaustion, and good lime content it is a valuable soil.

In the efficient utilization of this soil the first requisite is thorough drainage. A proper system of cropping and rotation is at present of secondary importance.

SOGN STONY LOAM

The surface soil of Sogn stony loam consists of a grayish-brown structureless silt loam mulch rarely more than 1 inch thick. This is underlain by dark grayish-brown friable silt loam, 4 or 5 inches thick, which has a well-developed very finely granular structure. This material is loose, friable, and thickly matted with grass roots but does not have the laminated arrangement of the soil particles which characterizes the corresponding horizon of the Hastings and Holdrege soils. As a rule the organic matter is fairly abundant and well decomposed. The resulting products are thoroughly disseminated throughout the soil mass, producing a dark grayish-brown color. The third horizon, which is 8 or 10 inches in thickness, is similar in texture to the overlying layers but is marked by its more perfectly developed granulation. It is composed of granular masses of well-rounded, slightly lighter colored aggregates from one-eighth to one-fourth inch in diameter. The aggregates have a faintly reddish cast. The fourth horizon is a zone of maximum compaction. The density is low, however, and the material remains friable, there being no suggestion of a claypan. It consists of heavy silt loam or silty clay loam of coarsely granular or cloddy structure, the individual lumps ranging from one-fourth to three-fourths inch in diameter. The color is dark reddish brown. Between depths of 25 and 30 inches the material is friable reddish-brown silt loam which is lighter in texture than that of the zone of maximum compaction and which is without definite structure. It breaks into rough, angular clods of many sizes and shapes and contains numerous filled-in wormholes and insect canals. This horizon grades into loose fragmental material containing small angular bits of limestone derived from the parent chalk rock which has given rise to this soil.

Owing to the topographic conditions under which this soil occurs, it is lacking in uniformity of development. On the more nearly

level areas where erosion is not active it commonly conforms to the description given. There is a great variation, however, in both the thickness and color of the several horizons and in the depth to the underlying rock. On very steep slopes, especially along the large drainage ways, the soil is shallow, capping bare walls of limestone which rise 15 or 20 feet above the adjacent valley floors. In such situations, as well as in areas subject to severe erosion, the surface dust mulch is rarely preserved except in protected areas. As a rule the remaining surface layers have lost much of their organic matter and are greatly thinned by washing. Many of the fields are marked by light-gray or white spots, the white calcareous material, or bedrock, lying only a short distance below the surface. The bedrock is the straw-colored and soft Niobrara chalk rock which underlies much of the county.

This soil, as mapped, includes all the areas of rough stony land adjoining streams which have cut into the Niobrara chalk and all the areas of deeper-weathered soils derived from this formation. It occurs along nearly all the streams and major draws in the uplands south of Republican River and along the lower courses of a few of the larger drainage ways north of Republican River. Other long, narrow strips running along the valley sides and extending for short distances into the more severely eroded uplands are along the south valley sides of the Republican River Valley. The soil also embraces parts of the valley basins in many of the tributaries of Republican River. Topographically it occupies a position intermediate between the upland loess soils and the valley alluvial and colluvial soils. On the upper slopes, therefore, it grades into the Hastings or Holdrege soils and in these situations the surface soil has, in places, been modified by silt from the higher loessial soils. The boundary line between the several soils at these points is purely arbitrary.

The surface of this soil is commonly steep and rolling along the larger streams and gently rolling on the broader divides between drainage ways. Toward the lower courses of the streams the draws descend rapidly and drainage has cut deeply into the underlying limestone. In such situations the soil is thin and rocky. Where it is badly dissected by branching tributaries, its surface is a succession of irregular divides separated from one another by stony, rough slopes.

This soil is excessively drained. The steep slopes carry off the rainfall rapidly, so that only a small percentage enters the soil. Where water enters the soil the slight depth to bedrock makes a local water table and soon causes a large part of the surplus moisture to escape as seepage or springs along the contact zone where erosion has exposed the bedrock.

This soil is unimportant agriculturally because of its shallowness, droughtiness, and topographic position. Much of it is too rough and stony to be cultivated. With the exception of the areas where the rock crops out, the soil supports a good growth of native grasses. A small part of the land is used for the production of hay, but the greater part is utilized for pasture.

Small acreages of corn, sorghum, Sudan grass, and other forage crops are planted in the more nearly level areas or near the contact zone between Sogn stony loam and the rolling phase of Holdrege silt loam. Neither the relief nor the character of the soil is favorable

to the retention of moisture, and crop yields are apt to be discouraging in normal years, as rainfall is the most important element in the agriculture of nonmoisture-holding soils in the county.

The draws dissecting Sogn stony loam generally support tree growths of elm, box elder, ash, cottonwood, and other species along their channels. The high-lying contact zone of Niobrara chalk and the overlying sandy materials favor constant seepage along the surface of the chalk, and many of the drainage ways carry water for the greater part of the year or their water table lies so close to the surface as to be favorable to tree growth. The drainage ways are of twofold importance. They supply drinking water for the grazing animals (largely cattle) either directly from their channels or through valley wells, and the tree growth along them supplies the cattle with shade.

Sogn stony loam, colluvial phase.—Sogn stony loam, colluvial phase, is closely associated with typical Sogn stony loam. Its important difference is one of surface features and origin. The typical soil is derived from material which has weathered directly from the limestone, whereas the phase has been derived from débris moved to a lower position.

The surface soil of this soil is gray or grayish-brown stony loam rich in sand and calcareous grit. It is commonly 10 or 12 inches thick. With depth it grades into a coarser-textured subsoil, lighter in color than the surface and very rich in lime. This grades, at a depth of 2 or more feet, into disintegrating limestone which is simply débris from the higher-lying Niobrara chalk. Limestone fragments are in most places more or less abundant throughout the entire soil.

This soil occurs in narrow strips along the base of Niobrara chalk outcrops in Republican River Valley. Similar strips also lie along the ravines of the southern hilly uplands, but these are too narrow to be shown on the map and are included with the typical soil.

Areas of this soil are moderately sloping, as it occurs in colluvial positions along Niobrara chalk escarpments. Owing to its position and texture, it is well or excessively well drained and is inclined to be droughty.

This soil is not important, owing to its small extent. Where it is included with fields of other soils, it is planted to the crops common to the region, but the larger part of it is used for grazing. It supports a fair growth of the common pasture grasses.

NUCKOLLS LOAM

In its normal development, the surface soil of Nuckolls loam is made up of three fairly distinct layers or horizons. The upper, or surface layer, is commonly very dark grayish-brown silt loam or very fine sandy loam which varies from a mere film to about 1 inch in thickness and is a loose mulchlike covering, similar in character to that on the Hastings soils. The second horizon is differentiated from the immediate surface layer on the basis of its structure. It is usually 10 or 12 inches thick and is similar in color to the dust mulch but has a faintly laminated or platy structure in the upper part. The third horizon is made up of finely rounded granules which average about one-eighth inch in diameter. It is loose, mellow loam containing considerable very fine sand and fine sand and a fairly high percentage of organic matter which thoroughly permeates the structure particles.

Filled-in insect or worm canals are not common, but scattered, well-rounded worm casts in a few places still retain portions of their cystlike envelopments. The granular layer is underlain by an 8-inch or 10-inch layer of material which is more or less transitional to the underlying zone of maximum compaction. The transition zone is a trifle more compact than the granular zone but otherwise is similar in color and texture. The zone of maximum compaction, which is also the upper horizon of the subsoil, is light reddish-brown heavy silt loam which continues to a depth of about 36 inches. The material is readily crushed between the fingers, however, and is fairly friable under normal moisture conditions. Its structure is coarser than that of the granular zone, the soil aggregates varying from one-fourth to one-half inch in diameter. The color is somewhat mottled, owing to the presence of numerous old insect and worm holes filled with darker material, but the entire layer has a reddish cast or tinge. The content of organic matter is lower than that of the upper horizons, the carbonaceous material occurring as a thin coating on the structure particles. The lower, or bottom horizon, is characterized by a faintly developed columnar structure and a high lime content. It is the zone of maximum lime accumulation and consists of friable, structureless silt, of which the basic color is light reddish brown and which contains much white lime in the form of soft and hard concretions and filmlike blotches and streaks. Filled-in insect borings are few and their color is commonly slightly darker than that of the soil mass. The soil, at a depth varying from 3 to 5 feet, merges with the parent material of pale reddish-brown silt of columnar form. Lime is present, but it is fairly uniformly distributed and the quantity to a unit volume is less than in the zone of lime accumulation.

The thickness and color of the surface soil vary with the relief and severity of erosion. On the gentler slopes the color is very dark brown and the surface soil is thick. On the steeper hillsides, on hill shoulders, and on minor ridges, erosion is severe and the surface soil has been greatly thinned or entirely removed, exposing the characteristic reddish-brown upper subsoil layer. On the moderate slopes, some patches have a decidedly reddish cast, a surface phenomenon which is characteristic of this soil throughout its area. Locally the surface soil contains considerable coarse sand and gravel, derived probably from the associated sand and gravel deposits occurring within or underlying the soil.

This soil occurs principally along the drainage ways of all the major streams of the county. Some areas are along the valley slopes, and others extend over divides or occupy the entire drainage basin of a stream. Long narrow strips are along Little Blue River and Spring Creek Valleys, and elongated, narrow areas are along many of their tributaries. A few areas are mapped in the southwestern hilly uplands. Where this soil occupies the sides of small streams and the lower valley slopes, the upper slopes are mantled with the Hastings or Holdrege soils. The lower slopes adjacent to the bottoms of many drainage ways are in places occupied by these soils, the silt having slipped from the higher soils and accumulated at the edge of the valley floor. Owing to the narrow linear and irregular occurrence of many of the strips of those soils which floor the very narrow valleys they have been included with Nuckolls loam in mapping. Nuckolls loam,

therefore, although shown in more or less continuous bands, strips, and areas embracing the middle and lower slopes of the valley sides, is not always as continuous as is indicated on the soil map. In the southwestern part of the county, patches of this soil too small to be shown accurately on the soil map have been included with neighboring soils.

Nuckolls loam has weathered from the reddish-brown sandy clay formation underlying the light-colored loess. The exact nature of this formation is not well understood, but it is thought to represent a loess older than the one from which the Crete, Holdrege, and associated soils were derived. The material is known in the Nebraska surveys as the Loveland phase of the loess.

This land varies in relief from gently to steeply rolling, and locally the surface is rough and extremely gullied. The surface drainage is excessive or severe. The soil is not important in the agriculture of the county because of its topographic position. About 35 per cent of it is under cultivation. The native vegetation in untilled areas consists of the same species of grasses which mantle the Holdrege soils. The more gently rolling and sloping areas are adapted to all crops common to the region, but yields are slightly below those of the associated upland soils. Corn is the most important cereal crop, and alfalfa is the chief forage crop.

Methods of managing the crops are similar to those practiced on the Holdrege and Hastings soils, except that the more progressive farmers endeavor to keep the soil in cover crops to retard erosion. No commercial fertilizers are used, but barnyard manure is applied by some farmers in an effort to improve the bare red spots. Sweet clover, alfalfa, or other legumes are grown, as they not only act as permanent cover crops but increase the nitrogen and organic-matter content of the soil.

CHEYENNE GRAVELLY SANDY LOAM

The surface soil of Cheyenne gravelly sandy loam, to a depth varying from 10 to 15 inches, is brown or grayish-brown gravelly sandy loam. This is underlain by grayish-brown gravelly sand. Both surface soil and subsoil are locally calcareous, owing to inclusion of lime fragments derived from the country rock.

As a whole, there is no marked difference between the surface soil and subsoil, except in color. The slightly darker color of the surface horizon is due to its content of organic matter, but the entire soil is deficient in that material.

Cheyenne gravelly sandy loam occurs along the low terraces and first bottoms of the larger drainage ways which empty into Republican River from the north. The material has been derived through wash from the higher-lying rough stony land areas and the outcrops of sand and gravel underlying the loess. The material has been only slightly reworked during transportation, and the soil is so young that no profile characteristics have developed.

Owing to the exceedingly open structure of both the surface soil and subsoil, drainage in most places is excessive and the soil is droughty. The surface is smooth, with a very gentle slope down the valley.

This soil has little agricultural importance, owing to its coarse texture and droughtiness. About one-half of it is under cultivation, however, because the areas are included in bodies of soils which are more productive. The uncultivated areas are used for pasture and support a thin stand of sand grass and small patches of grama, buffalo, and wheat grasses. Corn is the principal cultivated crop. Fair yields are obtained in favorable years. The soil is well adapted to potatoes, melons, and truck crops in seasons of sufficient rainfall.

No commercial fertilizers are used, but large quantities of manure are needed to increase the low content of organic matter. The extensive application of manure, however, is probably not profitable, under the prevailing market prices of land in this section.

VALENTINE LOAMY SAND

The surface soil of Valentine loamy sand is brown or grayish-brown, loose, loamy sand 8 or 10 inches thick. The subsoil is incoherent gray or yellowish-gray sand, lighter in color and coarser in texture than the surface soil. On low ridges and knolls where conditions have not favored the incorporation of organic matter, the soil is very loose and incoherent but in the pockets it is darker, contains more organic matter, and is fairly coherent. The sand grains are chiefly quartz and feldspar. In general, both surface soil and subsoil are deficient in organic matter and lime. Usually the soil tends to blow where the protective covering of grasses is removed.

Valentine loamy sand is not extensive in Webster County. The areas are widely scattered, the largest ones being mapped in sec. 30, T. 2 N., R. 9 W., and vicinity. Another area is in sec. 13, T. 2 N., R. 10 W. and another in sec. 26, T. 2 N., R. 12 W.

Areas of this soil are gently rolling. Drainage is good or excessive, as the loose, porous sands afford ample inlet and outlet for all surplus water. The soil is unusually retentive of moisture, however, considering its loose structure. This moisture-retaining capacity is a feature which characterizes the Valentine soils.

This soil has developed from the sand sheet underlying the loess. It commonly occurs in close association with areas of rough stony land, from which it differs chiefly in its finer texture. Small areas are included with rough stony land or the neighboring Holdrege silt loam, rolling phase in mapping.

Valentine loamy sand is of little agricultural value in the county, as it is subject to drifting when cultivated and its total area is small. The cultivated parts are usually planted to corn. The pastures support a fair growth of native grasses, chiefly bunch, buffalo, and grama grasses. Little grass is cut for hay, the uncultivated areas being largely pastured with cattle.

FILLMORE SILT LOAM

Fillmore silt loam is an upland soil having a black claypan layer in the upper part of the subsoil. It has weathered under conditions of comparatively poor drainage, although at present most of it has sufficient natural drainage for limited crop production. The surface soil is friable and ranges from less than 6 to about 14 inches in thickness there being apparently no regularity in the depth to the subsoil. Where thinnest, it is commonly composed of two layers. The upper

is dark grayish-brown, semigranular, heavy silt loam 1 or 2 inches thick. The lower layer may be either almost black or light gray depending on drainage conditions. Where the soil is well drained the layer is generally very dark, but where drainage is poor it may be almost white. It is usually laminated or similar in structure to the second layer of the Hastings and Crete soils. Where the surface soil is thickest the two surface layers are both very dark and a third layer, from 3 to 10 inches thick, has developed. The latter layer is friable, imperfectly granular, and almost black silt loam in the upper part but is more or less sprinkled throughout with white, floury silt which becomes increasingly abundant with depth and often masks the naturally dark color of the granules in the lower part. In the more poorly drained areas the white silt may become so abundant as to form a thin, usually laminated, fourth layer beneath the granular material. The fourth layer, when present, seldom increases the average total thickness of the surface soil, as the third or semigranular layer is thinner in the poorly drained situations. The white floury silt somewhat resembles volcanic ash and is so called by many farmers. It has no abrasive qualities and is simply a product of soil weathering.

Beneath the variable surface soil is the subsoil consisting of two layers. The upper consists of black, structureless clay. It is a true claypan, being extremely compact and comparatively impervious. It is from 12 to 24 inches thick and contains scattered black, hard, concretionary forms which are round, or nearly so, and are from one-eighth to slightly more than one-fourth inch in diameter. They commonly have slightly pitted surfaces. The lower subsoil layer is characterized by its high lime content. It consists of structureless silt, grayish brown in color and moderately compact in the upper part where it joins the claypan. It becomes rapidly lighter in color and more flourlike with depth. Visible lime, chiefly in the form of concretions, spots, and splotches, is abundant to a depth varying from 8 to 12 inches in the layer, but it gives way to finely disseminated lime at a depth of about 5 feet beneath the surface. 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. It is the formation from which the soil has weathered. The loess contains no lime to a depth of 4 or 5 feet.

Except for the variations in the surface soil, Fillmore silt loam is remarkably uniform throughout the area of its occurrence in Webster County. The light-colored floury silt layer, when present in the surface soil, may locally be stained with rust-brown streaks and spots in the lower part, and the immediate surface layer may contain a sufficiently heavy sprinkling of gray silt to give it a much lighter color than typical. In fact, a considerable part of the surface soil has a decidedly grayish cast, but the variations mentioned are unimportant and their distribution is not shown on the soil map.

Fillmore silt loam occurs only in a few small depressions throughout the more nearly level uplands. A typical area is about 2 miles south of Eckley School in Beaver Creek Township, and several areas are in the vicinity of Bladen. A number of small patches occur in the northwest corner of Catherton Township. Few of the individual areas exceed 80 acres in extent, and the total area is less than 1 square mile.

Owing to the flatness of the surface and the position of most of the soil in shallow basinlike areas, surface drainage is poorly established, although there is commonly sufficient slope to slowly remove the surplus surface water into the lower part of the depressions. The soil in most places is dry enough for cultivation. It is difficult to establish artificial drainage for the lower and more poorly drained areas because the surrounding land is higher. The value of artificial drainage, moreover, is extremely doubtful because the comparatively impervious claypan prevents free water movement and retards root development to such an extent as to greatly reduce the agricultural value of the land.

Owing to its small extent, imperfect drainage, and low productivity Fillmore silt loam is unimportant in the agriculture of Webster County. Many of the smaller areas are regarded as waste land and are not cultivated. Most of the larger areas are included in farm pastures or are used for the production of wild hay. The native vegetation includes a variety of moisture-loving grasses in the lower areas and buffalo, grama, and wheat grasses in the drier areas.

ROUGH STONY LAND

Rough stony land consists principally of small scattered hills and swells, the material of which is composed of grayish-brown loamy sand containing a high percentage of angular and rounded gravel and small cobblestones. Locally the admixture of gravel and similar coarse particles is small, but typically the surface presents an area roughened by rounded rock and mineral particles from a fraction of an inch to several inches in diameter. The rocks are both basic igneous and granites, and the few mineral particles are largely quartz with some feldspar. The subsurface layers consist of lighter-colored sand and gravel varying from fine to coarse in texture, and in places are uniform enough in texture to be worked as sand or gravel beds.

The land includes areas of stony loam, fine sandy loam, and loam, too small to map. Most of the stony loam areas occur on knolls and the fine sandy loam and loam areas in pockets where conditions have favored the collection or retention of silt and clay particles.

Rough stony land occurs principally in the lower valleys on the sides of the main drainage ways dissecting the uplands in the tier of townships designated T. 2 N. It also occurs on local divides forming chains of low, pebbly hills which extend irregularly along the valley or occupy most of the local basin below the higher-lying soils of the rolling phase of Holdrege silt loam.

The surface of this soil is rolling or hilly. Drainage is naturally excessive on account of the topographic position, the porous structure, and the friable consistence. The land is accordingly droughty and suited only for grazing. The grass growth is scanty and poor, owing to the low moisture conditions to which the plants are subjected. Buffalo, grama, and wire grasses, and occasional yucca or soapweed are to be found.

The material of which this land is composed is probably from the gravel and sand deposits which underlie the loess in the county and which are the principal water-bearing horizons of the uplands. There are no prominent exposures south of Republican River. The more

shallow entrenchment of Little Blue River and its tributaries in the northern township have not exposed this substratum, although it is reported in the deeper well borings.

SUMMARY

Webster County is the central county in the southern tier of Nebraska counties. It includes 573 square miles or 366,720 acres. Red Cloud is the county seat.

The general surface of the county is that of a plain, but there are four natural topographic divisions or regions. These are the flat northern uplands, the rolling central uplands, the Republican River Valley, and the southern hilly uplands. These divisions have been made by Republican River and its tributaries from the flat loess plain which originally covered most of eastern and southern Nebraska.

The average elevation of the uplands is about 2,000 feet above sea level. The slope is to the southeast. Republican and Little Blue Rivers are the principal drainage ways.

In general, Republican River with its tributaries drains the three southern tiers of townships, and Little Blue River drains the northern tier. The tributaries completely ramify all parts of the county, except the level parts of the flat northern uplands where water gathers in shallow basins and evaporates or sinks slowly into the ground.

The first settlement in the county was made near Guide Rock, and the county was organized in 1871. Settlers came from eastern Nebraska, and from many other States east of the Missouri River. In several settlements inhabitants are of foreign extraction.

The county is well served by railroads, no part being more than 10 miles from a shipping point. Two State highways cross it from north to south and from east to west, respectively. The main roads between towns are usually kept in good condition. Livestock is marketed in St. Joseph and Kansas City, Mo., but wheat is sold in Omaha.

The climate is healthful, but agriculturally its variability results in wide fluctuations in the yields of all crops. Under average conditions the precipitation and frost-free season are fairly adequate for farming under the present system.

Since the first settlement in the county the increase in the acreage of wheat has been steady, until to-day it is nearly equal to that of corn, the leading crop. The secondary major grain crops include oats and barley. The chief hay crops are alfalfa, wild hay, and members of the sorghum group. The livestock include cattle, hogs, and work animals.

In 1922, 57 per cent of the county was under cultivation, and the Federal census of 1920 reported that three-fourths of the land in farms was improved. More than one-half of the county is occupied by renters, and only two-fifths of the farms are occupied by owners.

The soils of the county are characterized by their dark color, the development of a zone of lime accumulation, and a more or less well-developed granular structure in both the surface and subsoil layers.

Crete silt loam is the principal soil of the smooth, level uplands and is the principal wheat soil of the county. It is also used for corn, oats, and the minor crops of the region.

Hastings silt loam is a well-drained upland soil, one of the best in the county. About 90 per cent of this land is cultivated, mainly to the general farm crops of the county.

A rolling phase of Holdrege silt loam covers most of the drainage ways, slopes, and bluffs of the county and is used widely for grazing or the production of hay. Wheat, alfalfa, oats, rye, barley, sorghum, and Sudan grass are the leading secondary crops. The soil is well adapted to corn and alfalfa.

Nuckolls loam is a slope-land and narrow ridge-crest soil developed below the Holdrege soil. Its characteristic feature is its reddish color which produces red spots on the severely eroded valley sides. It is not important agriculturally, owing to its small area and unfavorable relief.

Sogn stony loam is a dark-colored soil having a loose, calcareous subsoil. The soil is thin, rocky, and rough, and is largely used for grazing.

Hall silt loam occurs on the high terraces of Republican River, on the second bottoms of many of the streams of the county, and in colluvial positions near the base of Niobrara chalk outcrops. All crops common to the region are grown.

The Cass soils are dark-colored flood-plain soils having light, sandy, calcareous subsoils. Corn and alfalfa are the principal crops. The nearness to the surface of the water table and the high lime content of the subsoil insure the most favorable growing conditions.

The Sarpy soils are light-colored sandy soils, with loose sandy subsoils. They are deficient in organic matter. Corn is the principal crop.

Wabash silt loam, light-subsoil phase, is an excellent dark-colored soil. It occupies the flood plains and low terraces of most of the large drainage ways in the county. All crops common to the region can be grown on it, and it is important in the livestock industry.

The Lamoure soils are heavy, dark-colored soils and usually are well drained. They are excellent for alfalfa, and corn and oats are important grain crops.

Cheyenne gravelly sandy loam is a light-colored, droughty soil. It is unsuited to farming, being largely used for grazing purposes.

Rough stony land is a miscellaneous class of land suited only to grazing.



[PUBLIC RESOLUTION—No. 9]

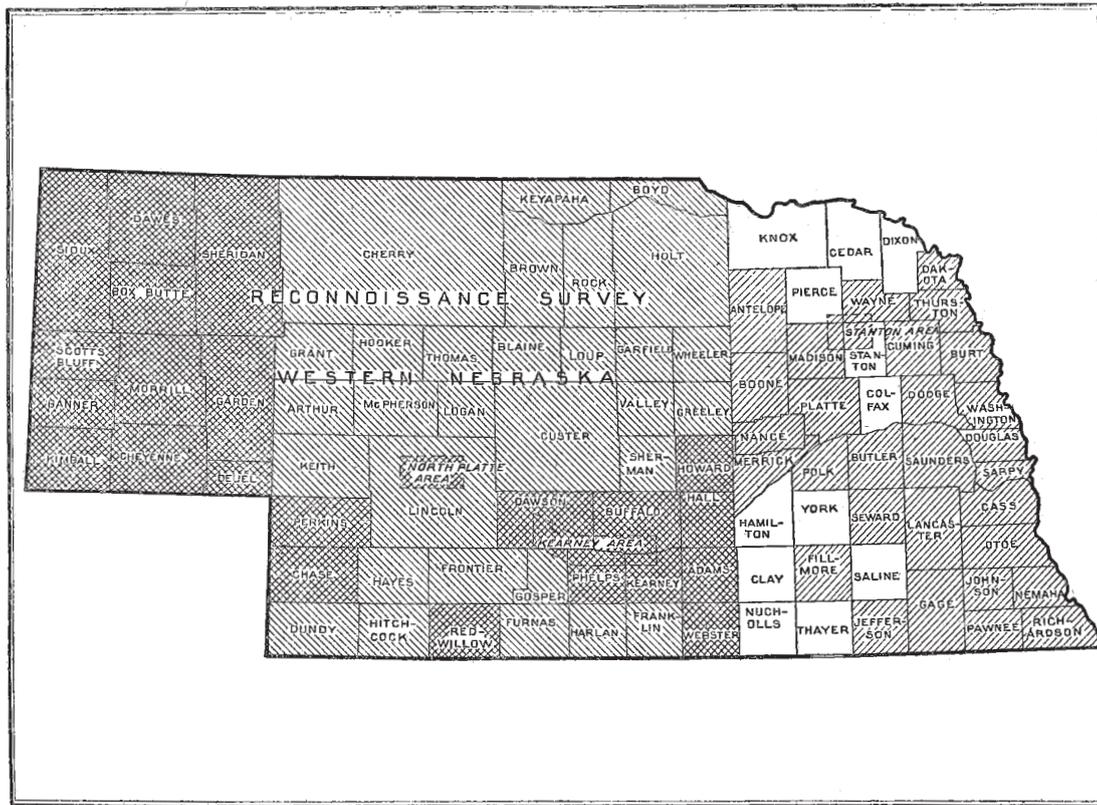
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture"

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.]



Areas surveyed in Nebraska, shown by shading.

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